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Induction Coils. IN another column we describe an interesting departure in the construction of induction coils, in which an attempt is made to bring the primary conductor in as close proximity as possible to the secondary. While this form of double conductor is not new in itself, having already been proposed in connection with telephone circuits, its present application is decidedly interesting, and it seems probable that it may be employed to advantage for such purposes.

Experiments on Alternating E. M. F. Curves. WE continue in this issue a description of the experiments on induction coils made by Dr. Louis Duncan and his associates, which show some very interesting results regarding the curves of E. M. F. in this class of apparatus obtained under varying conditions. It will be noted, however, that these curves were obtained with the aid of an alternating machine the armature of which contained no iron; and hence in actual practice allowance must be made for this variation when applying them to apparatus in which the generator contains iron in the armature. As they stand, however, the results are of decided value, and seem to show that the curve of E. M. F. under these conditions approximates very closely to the simple sine curve.

Advances in Train Lighting. THE use of electric lighting on trains in Europe has been attended by very encouraging results, as reported by Herr Voigt lately before the Frankfort branch of the Society of German Engineers. On the Wurtemburg roads, where electric lighting has been in use some time, the average expense is shown to be considerably below that of oil gas, and though the cost of the plant is a little heavier, the apparatus itself is lighter, so that less weight has to be pulled by the locomotive. It is also mentioned that an engineering firm at Esslingen has already fitted up a number of trains for electric lighting, of which six are running on the Novara-Seregno road in Italy, and others on the Russian Southwestern line. These trains, it would appear, carry their own dynamos, as they are occasionally boarded by an attendant, who oils the machinery, which seems otherwise to be left pretty much to itself. Further details would be interesting, but enough are given to show that train light in Europe, as here, is very much on the advance.

Electric Meters. THERE seems at the present time to be a general adoption of the idea that one of the most desirable methods of obtaining the measure of a current passing through a circuit, consists in the application of the principle of the heating effect of the current. Not long since we described Professor Forbes' ingenious meter, in which the heated conductor generates currents of air which set the vanes in motion, connected with a registering train. In this issue we describe the apparatus designed by Professor Thomson, in which the same principle is applied in a different but equally skillful manner, and in which the vaporization of a volatile liquid is employed to effect a reciprocating motion, the rate of which is determined by the strength of the current, and hence serves as a means of registering the same. We are evidently just upon the beginning of an era of special work in this field, and the result will no doubt be a large variety of this class of meters.

Electric Versus Cable Roads. A VERY strong opinion in favor of electric as compared with cable roads has just been given by Col. Henry Flad, one of the foremost civil engineers in this country and at present at the head of the Board of Public Improvements in St. Louis. Col. Flad recognizes the many advantages of the cable system, making it an improvement over animal power, but he believes that "its application will soon be confined to the operation of lines on which heavy gradients occur." He speaks of what he has seen of the cable system in St. Louis and states that on the largest cable roads there the effective force of traction is only 15 to 20 per cent. of the power of the engine, while the troubles and interruptions have been numerous and serious. In his opinion it is the storage car that is destined to supply the necessities of all our large street railroads, except those of very heavy grades, and the chief recommendation in his eyes is the fact that each storage car is an independent unit. "The importance of this, particularly in large cities and with long lines, cannot be overestimated; and I would recommend the electric motor, with storage batteries, even if a cable road could be constructed and operated at less expense."

Life of Incandescent Lamps. THE discussion of Mr. Howell's recent paper before the American Institute of Electrical Engineers touched upon the very interesting point regarding the life of incandescent lamps as dependent on the nature of the current employed. Statements have been made at various times in favor of both the alternating and the continuous current as supplied from dynamos, and some have strongly urged that lamps supplied by storage batteries are specially given to long lives. The final stand taken by those who discuss this question is, probably, the only tenable one, and that is, that only a severe and rigid test, with conditions uniformly maintained, can decide this question. Lamps of identical quality may vary greatly in their lives according to the manner in which they are handled, and nothing short of a definite condition of running can give the final settlement of the dispute. Probably one of the most significant points brought out during the discussion was the fact that while under proper supervision, and with suitable arrangements, the storage battery can be depended upon to give a current of great uniformity, the methods at present employed in the installation of such batteries involves a variation in the E. M. F. at the terminals of the lamp which cannot fail to be seriously prejudicial to their lasting qualities. An actual instance of this as described by one of the speakers shows that greater care is required in the installation of such plants.

The National Electric Light Association. THE fact that the Executive Committee of the National Electric Light Association holds a meeting in this city next week, reminds us of the near approach of the next convention, which, it is understood, is to take place here. The readiness of the committee to grapple with its work is a good sign, and as the committee is stronger in ability and in men who can give their time than it has been for a long while past, the brightest hopes may be entertained as to the success of the meeting. While New York is by no means the best place in which to hold a convention during the hottest days of summer, there is little doubt that it will be made endurable to visiting delegates by a hearty hospitality. It is not too early for the committee to invite the co-operation of all New Yorkers interested in electric lighting, for entertainment purposes, so that whatever is done in this respect may be done with united effort and with the greatest result. Passing to more serious topics, it may also be in order, perhaps, to suggest that the committee might see how far it can help on the work as to insurance and licenses so well begun by the Boston Electric Exchange. This subject is one of importance to every local lighting company, and the association could, we think, devise a scheme by which uniformity of practice would be attained throughout the country. Another matter to which attention might, perhaps, be profitably given, is that of watching legislation, State and municipal, which, now that local companies are found to have valuable property or franchises and to be on the increase, becomes more and more frequent, and often takes the threatening form of a "strike." For some time past, Mr. H. L. Storke has made admirable reports to the National Telephone Exchange Association on telephonic legislation, and his work might well be duplicated in the electric lighting field. It is possible, however, that these and many other points have already been noted or considered by the Executive Committee.

Designing Dynamo-Electric Machinery. IT is only since a comparatively short time that the designing of dynamo-electric machinery has been reduced to what might be called rational methods, and the treatises which have appeared on this subject are splendid achievements of mathematical analysis based upon experimental data. Among these may be mentioned particularly those of Hopkinson, Kapp and others. But while these methods are easily handled by those who have had mathematical training, that is, by electrical engineers in the true sense of the word, there are, nevertheless, not a few greatly interested who cannot be classed in that category, but are actively engaged in this line of work. They might to a certain extent be called electrical mechanics, whose work is dependent more upon the result of "cut and try" methods than upon the results of experience as shown in best practice. That this class is numerous we are in a position to know by the many inquiries which constantly reach us regarding the method of proportioning various parts of dynamo-electric machinery. To such the paper read by Mr. Crocker before the New York Electrical Society will, we think, be a decided boon, as he shows therein that without the use of complicated formulæ the various constants of dynamos and motors can be calculated from the results of past experience. Probably the most striking element to which the attention of the student may be drawn is the enormous influence which the air space between the iron of the armature core and that of the pole piece exerts upon the amount of ampère turns required to obtain a given strength of field. Thus, as shown, the difference of ¼ inch in this space may effect a saving of nearly 40 per cent. in the amount of wire required on the field. As the rules deduced by Mr. Crocker have been found to apply very well to some of the best machines constructed, it is safe to say that with proper precautions they may generally be applied to a large variety of work, and he will, no doubt, earn the gratitude of those—many in number—who are still unable to digest the more complete treatises on the subject.

The Magnetic Club. THE desire for greater social intercourse and for the promotion of various praiseworthy objects has led the telegraphers in this city to form the Magnetic Club, which, starting on a very modest basis, promises to have a happy and useful career. For the present the membership is limited, but as it is proposed to include all engaged in electrical pursuits, and as the burdens are practically restricted by the actual expenses of each quarterly meeting, shared among those who attend, it seems likely that the limit will soon be raised, especially as the applications are already so numerous from all quarters. We are glad to see this movement, and to give it the support which has never been denied in these columns to any plan aiming at the common good of the electrical profession. The benefit that comes from opportunities to "pour out heart affluence in discursive talk," and to discover the virtues of those from whom business competitions in ordinary life may separate us, is too evident to need pointing out; and our telegraphic friends, who have in their various societies given such remarkable proofs of their ability to work together successfully, may be counted on to do well again in this their new departure. If we might venture a word of advice, it would be that they give close attention to their rules of membership, so that entry or exclusion may not be made the means of insulting or injuring individuals who happen to be obnoxious to one or two in the management. While the danger in this instance is remote, it is unfortunately one from the scandal of which some clubs have not been free, for notwithstanding all that such bodies do to promote that pleasant intimacy between men which is one of the most agreeable marks of a high civilization, they also thus serve at times as tools for the wreaking of the meanest and pettiest spites and even as instruments of the worst jealousy. We understand that this question of membership came in for lively discussion at the preliminary meeting of the Magnetic Club, and therefore our remarks will be not less timely than they are well meant. The best and only wish one can have for all such institutions is their utmost harmony and prosperity.

Experiments on Induction Coils.—II.

BY DR. LOUIS DUNCAN, CARY T. HUTCHINSON AND GILBERT WILKES, JOHNS HOPKINS UNIVERSITY.

CONSTANTS OF APPARATUS.

Dynamo.—This was of the Siemens alternating type. It had 8 field magnets and 8 coils in the armature. At about 800 revolutions it gave approximately 50 complete alternations per second. The following are the constants:

Resistance of armature	7.00 ohms.
Resistance of field	1.40 "
Self-induction of armature removed from machine	$.082 \times 10^9$

Self-induction of armature in position was as follows:

Current in field.	Angular position of armature with respect to poles of field magnets.		
	0°	11¼°	22½°
0 amp.	$.120 \times 10^9$	$.112 \times 10^9$	$.100 \times 10^9$
2.5 "	$.125 \times 10^9$	$.115 \times 10^9$	$.108 \times 10^9$
4.5 "	$.128 \times 10^9$	$.115 \times 10^9$	? $.106 \times 10^9$

Mutual induction of armature and field:

Angular positions	0°	11¼°	22½°
Mutual induction	$.092 \times 10^9$	$.062 \times 10^9$	$.003 \times 10^9$

Self-induction of field	2.50×10^9
Induction coils.	
Resistance of primary of induction coil *A*	4.40 ohms.
" " secondary of induction coil *A*	1350 "
Self-induction of primary of induction coil *A*	$.65 \times 10^9$
" " " secondary of induction coil *A*	132×10^9
Mutual induction of primary and secondary	8.1×10^9
Resistance of primary of transformer *A'*	50.0 ohms.
" " secondary of " "	0.100 "
Self-induction of primary of " "	1.96×10^9
" " " secondary of " "	$.0047 \times 10^9$
Mutual induction of primary and secondary	$.098 \times 10^9$
Condenser.	
Capacity	4.72 micro farads.

The curves given in this paper represent mainly the differences of potential between designated points on the circuit; with each curve is shown a diagram of the connections used. The broken curve is a simple sine curve drawn to cross the axis with the observed curve and with the same maximum ordinate:

Exp. 1. Fig. 1 gives the induction through the field magnets in absolute units for different currents. The large air space between the poles causes the result to be similar to that obtained from a short, thick magnet; it is approximately a straight line.

Exp. 2. Figs. 2 and 2a. The curves of these figures represent the induction through the small and large test coils on the armature. A few observations only were taken for each curve, so that they are possibly not very accurate.

Exp. 3. Fig. 3 gives the rate of change of induction in different points of the field. It was obtained by connecting the armature coils with a ballastic galvanometer through a pointer making contact with the armature circuit through an arc of 3 degrees. The position of the pointer was changed for each observation and the armature given a quick turn. It was extremely difficult to get contact for exactly 3 degrees each time, and it seems probable that there may have been slight errors.

Exp. 4. Fig. 4 gives the curve of E. M. F. at the terminals of the dynamo on open circuit, full current and half current being used in the field.

Exp. 5. Fig. 5. The conditions are the same as in Fig. 4, excepting that a condenser is introduced in the circuit.

Exp. 6. Fig. 6. The induction coil was in the circuit, the secondary being open; the differences of potential were taken at the dynamo terminals.

Exp. 7. Fig. 7. The conditions are the same as in Fig. 6, excepting that the secondary was short circuited.

Exp. 8. Fig. 8. The potentials were taken at the dynamo terminals with the primary of the transformer in the circuit; the resistances in the secondary were 45 ohms and 5 ohms respectively. The curves obtained were very much alike.

Mr. Silvey on His Defense.

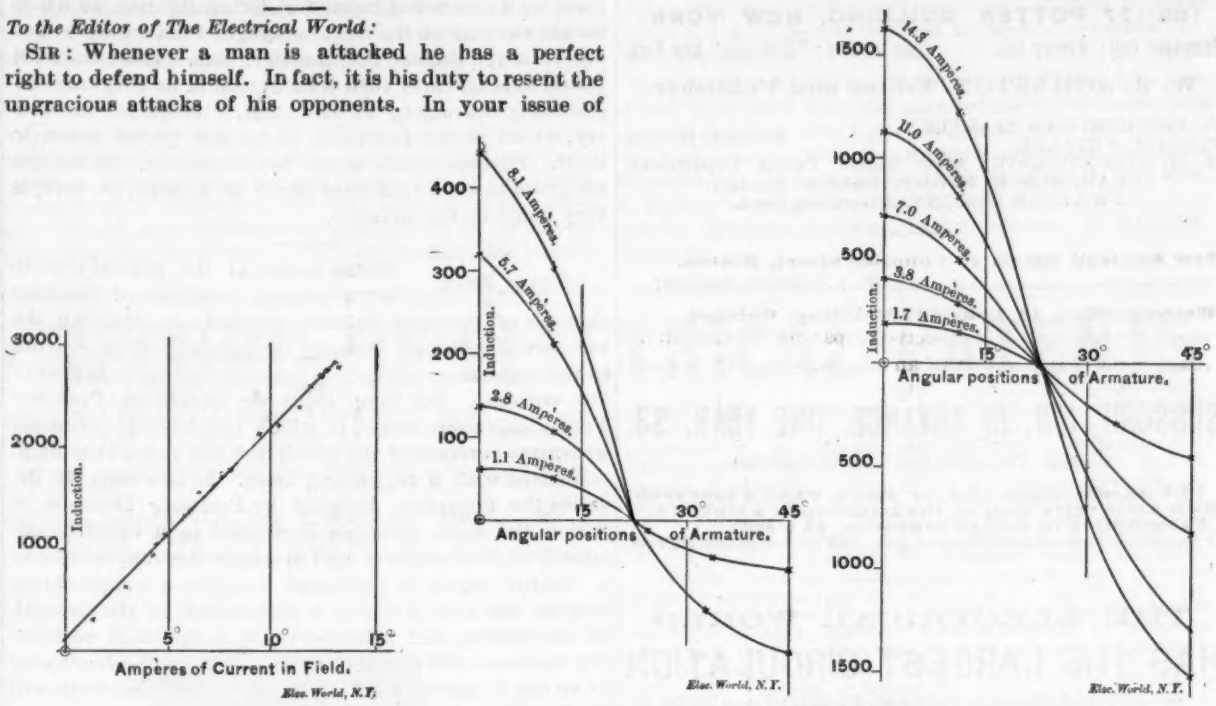
To the Editor of The Electrical World:

SIR: Whenever a man is attacked he has a perfect right to defend himself. In fact, it is his duty to resent the ungracious attacks of his opponents. In your issue of March 10 you were kind enough to publish a cut and description of a certain improved type of dynamo machine of which I claimed to be the author. Now again, in your issue of April 14, Mr. Gisbert Kapp asserts that he is the author of this very machine; or, in other words, that I copied his machine in every part, and as proof of this he refers to his book on *The Electrical Transmission of Energy*, page 269.

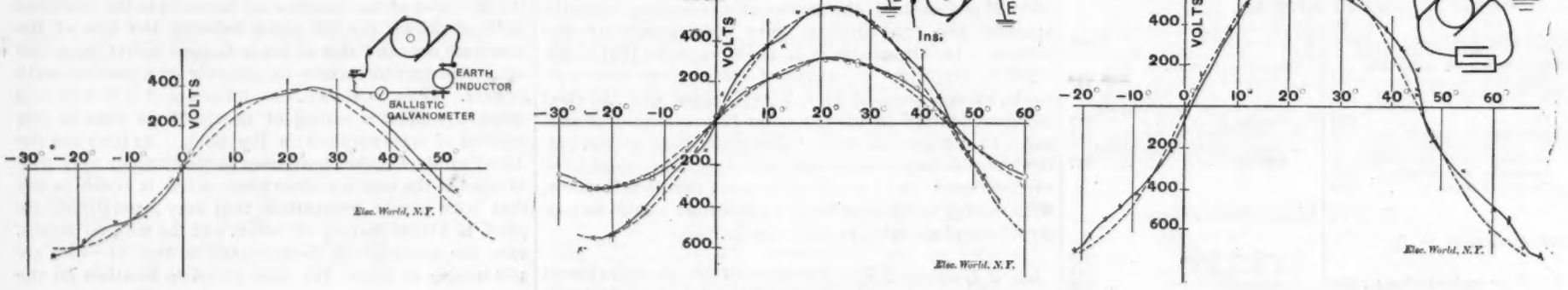
In order to set matters right, let us refer to Mr. Kapp's description of his armature on pages 267, 269 and 270; also to Prof. S. P. Thompson's work on *Dynamo-Electric Machinery*, page 135. In Mr. Kapp's book in describing his armature he says: "The core of the armature consists of iron wire coiled upon a supporting cylinder of gun metal, which in turn is keyed to the cylinder by two sets of arms. The cylinder is provided with flanges, partly for the purpose of stiffening it, and partly for the purpose of subdividing the body of the core into a number of comparatively narrow strips. The surface of the cylinder is perforated, and air can enter through the perforations into the annular spaces formed between the adjacent flanges and escapes at the outer periphery, since the latter is not completely covered by the external coils. The flanges are provided with radial extensions or 'driving horns,' which are tipped with fibre ferrules, and enter between the external coils for the purpose of transmitting the driving power to the copper conductors in a positive mechanical manner. * * * The author's high-speed dynamo for belt driving is shown in Fig. 104. Its armature is constructed as that above described, but the field magnet is different. It is a single horseshoe with cylindrical limbs of soft wrought-iron, the cast-iron bed-plate forming the yoke. The upper end of each core is turned to a cone, on which is fitted a cast-iron pole piece, intimate contact between the two being secured by the pressure of the top screw eye-bolt forcing the pole pieces well on the cone."

Referring to the description which you published of my machine, let us examine how closely it agrees to the description just given. "The armature is of the ring type, and is wound to a capacity of 300 lights. The weight of the armature core is 250 pounds, consisting of the best annealed sheet-iron insulated with paper, the iron being of No. 32 gauge. The armature is mounted on a peculiarly constructed spider, which is let into notches on the inside of the ring, being pressed together by a peculiar clamp. It is wound with 120 turns of square copper wire .2083 square inch in section, one layer deep on the top and two layers deep on the inside, all being joined to a 60-part collector.

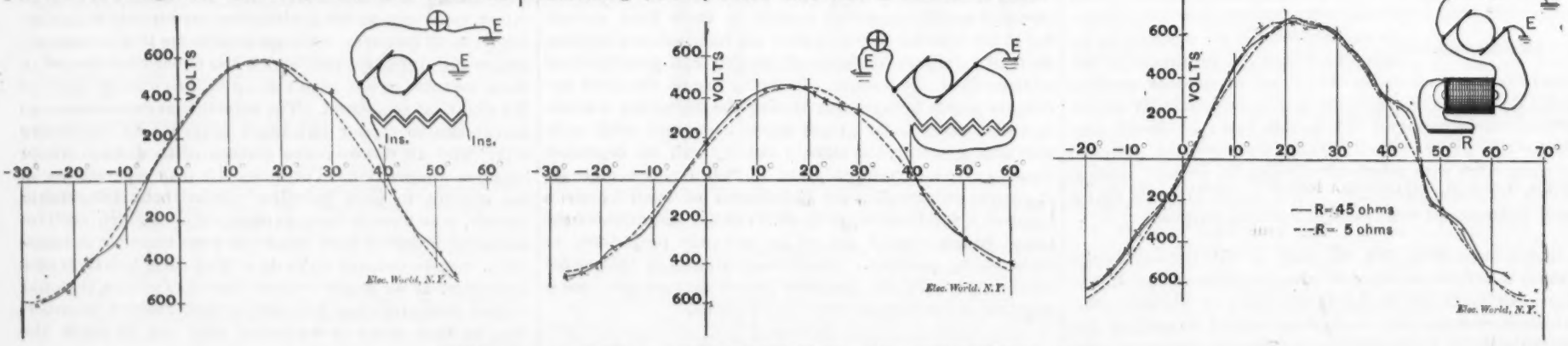
The resistance is very low and the regulation is said to be nearly perfect. The length of the armature core is 12 inches, outside diameter 12 1/16 inches. Over all there is wound a band of No. 14 iron wire to prevent abrasion and to draw down the magnetism of the field directly against the armature conductors. The field magnet cores are of the plain cylinder type, 10 inches in diameter and made of the best hematite iron. The coils are 12 inches long and the field is wound with wire .083 square inch in section in the shunt, with 40 turns of quadruple wire .2083 square inch in section in the series coil, the combined resistance being 25 ohms. The weight of the field core including pole piece is 600 pounds. The lower part of the



FIGS. 1, 2a AND 2.—EXPERIMENTS ON INDUCTION COILS.



FIGS. 3, 4 AND 5.—EXPERIMENTS ON INDUCTION COILS.



FIGS. 6, 7 AND 8.—EXPERIMENTS ON INDUCTION COILS.

field is expanded to give greater contact surface, by which the actual loss is reduced to a minimum." * * * Had I been the author of the article referred to I would have said that the spider which carries the iron rings of which the armature is composed is interlocking in the centre, so that when once the two halves of which the armature is composed are pushed together in the notches, the ring become as solid as a single piece.

Now, how Mr. Kapp could possibly construe this style of armature—which I have used for fully five years, and for which I have patents granted—to resemble his "obsolete" style of armature with the wire core and spaces to admit air to carry away the heat, is more than I can understand. In my machine I never had and never required air spaces, because my armature does not heat. Over the outside of my armature conductors I wind a solid band of iron wire, which I have used for the past three years, having been first used on my multipolar ring field machine. This improvement I have patents for in the United States; consequently, I am well aware that had they not been new I would never have received a patent, for the simple reason that the addition of an iron wire band of so solid construction increases the output fully 25 per cent.

Now as to the type of field—the inverted horse-shoe type—I can only say this: My first experiments with dynamos, in 1880-1881, were made with this style of field. The double electro-magnet at that time was well known, having been used by Morse in his first telegraph instrument and is the invention of Professor Henry, so that the fact of running an armature between the poles of a double horse-shoe magnet is not new with Mr. Kapp. Neither is the matter of winding a dynamo compound his invention, for we all know that it is a debatable question who first used this style of winding which Prof. S. P. Thompson attributes to Mr. Brush. As to my magnets, they are made of peculiar hematite iron—almost pure wrought iron—which we cast in our own foundry, while Mr. Kapp makes his pole piece of cast iron and the core of the magnet of wrought iron, when it is a well known fact that it is next to impossible to make intimate magnetic contact between a cast iron pole piece and a wrought iron core, with a conical joint between them. Another peculiarity is that I expand the lower part of my field to get my great contact surface, which Mr. Kapp does not.

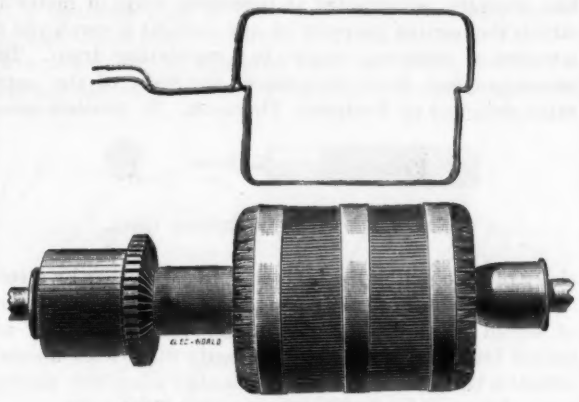
To sum it all up I cannot see wherein my machine is in any way similar to that of Mr. Kapp, although he would try to claim the authorship. If he can show that he invented any one part of the machine which I am using, and have been more or less since 1881, he is entitled to it and no more. But after his attack, to sum up, he says the machine is obsolete, thereby trying to convey the idea to the general public that there are better machines than the one I am identified with. If I were going to copy a dynamo machine I should not look 3,000 miles away for a fit type when I see so many good machines that are public property near at home. The Americans are too well-known as inventors of the telephone, the telegraph, and the first successful dynamo machine, from a commercial standpoint, to need to do much copying. The spirit of envy and selfishness can be plainly seen lurking in Mr. Kapp's article where he refers to the illustrious electrician, M. Gramme, thus: * * "though I believe M. Gramme introduced the same type either simultaneously or a little earlier in France." This is not a matter that surprises me much. But here he would attack me for using a type of machine which he claims as his own, and in almost the same sentence half admits that M. Gramme used it before him. Why does he not attack Prof. Elihu Thomson for using upright fields in his motor, or Mr. Daft, or some of the noted electricians of this country? He is afraid to. He knows they would reply. He would rather attack one whom he thought would be afraid to show up the true inwardness of the situation.

LIMA, Ohio. W. L. SILVEY.

The Eickemeyer Dynamo.

During the past year several descriptions of iron-clad dynamos, designed by different inventors, have appeared in our columns. Among others we have described and illustrated a new dynamo of the iron-clad type invented by Mr. Rudolf Eickemeyer, of Yonkers, N. Y. In this issue we give fuller illustrations and descriptions of this machine, as it is now manufactured by Messrs. Osterheld & Eickemeyer, of Yonkers, N. Y.

The chief features of novelty in this machine are the disposition of the field wire and the manner of putting on the armature wire. The accompanying engraving, Fig. 1, illustrates the machine complete, and Fig. 2 shows



FIGS. 3 AND 4.—THE EICKEMEYER DYNAMO.

the same with the pole pieces and one-half of the field coils removed from one side, in order to expose to view the manner in which the field wire is disposed about the armature. From these illustrations it will be seen that the field wire is wrapped about the armature in such a way as to make the armature core serve the double purpose of a core for the armature winding and also for that of the field winding. This is accomplished by winding the field wire directly about the armature and parallel to the armature wire.

In this manner both armature and field wire are encased in a cast iron shell, thus providing such a circuit for the magnetism produced by the current in the field wire that each magnetic whirl in the whole length of each turn of the field wire is obliged to include the armature core in its circuit, and it also has a complete circuit of magnetic metal, with the exception of the two places where it crosses the path of the revolving armature wire. So completely is this accomplished in practice that where sufficient area of cross section of iron is used in the shell, the machines have run under full load with scarcely a trace of external magnetism. This arrangement also allows the bearing for the armature to be cast as a part of the frame or shell, and obviates the necessity of using non-magnetic metal in any part of the frame.

The method of applying the armature wire is exceedingly novel, and presents a number of advantages over the more usual methods.

In the ordinary and well known way of winding armatures of the drum type, the wire of each section is wound on the core, one turn at a time, until one layer of a section, or the whole section, is completed. Then the next section is similarly wound, but at one end of the armature it crosses over the section first wound in such a manner that, in order to remove one section of such an armature, all sections wound after it must first be unwound. Other well-known disadvantages connected with this method of winding an armature are: the difficulty of maintaining good insulation between the crossed wires at the ends of the armature; the inequality of the length of wire, and therefore of the resistance in the sections; the inability to cover the entire periphery of the drum, and the amount of space required by the wire at the ends of the armature, Mr. Eickemeyer's method is designed to obviate all of these difficulties.

Each section of a given armature is separately wound on the same winding frame, and thoroughly insulated before being put with the others on the armature core.

Figs. 3 and 4 show in front elevation a single coil and the armature complete with the coils in place. The armature here shown is wound with but one layer of wire, and each coil has two turns in it. The sections are so formed and fit into each other in such a way that they can either be put on the core or removed therefrom, one at a time, without in any way injuring the other sections. It will also be observed that the turns of each section are parallel throughout their entire length, and nowhere does one wire cross another.

As will be seen in Figs. 2, 3 and 4, each section is parallel to its neighbor throughout its entire length, and the sections are so placed on the periphery of the core that the entire surface is symmetrically covered with wire. Spaces are provided at the ends of the core and near the circumference for the insertion of pegs, which aid both in putting the coils in their proper place on the core and also in keeping them in that position.

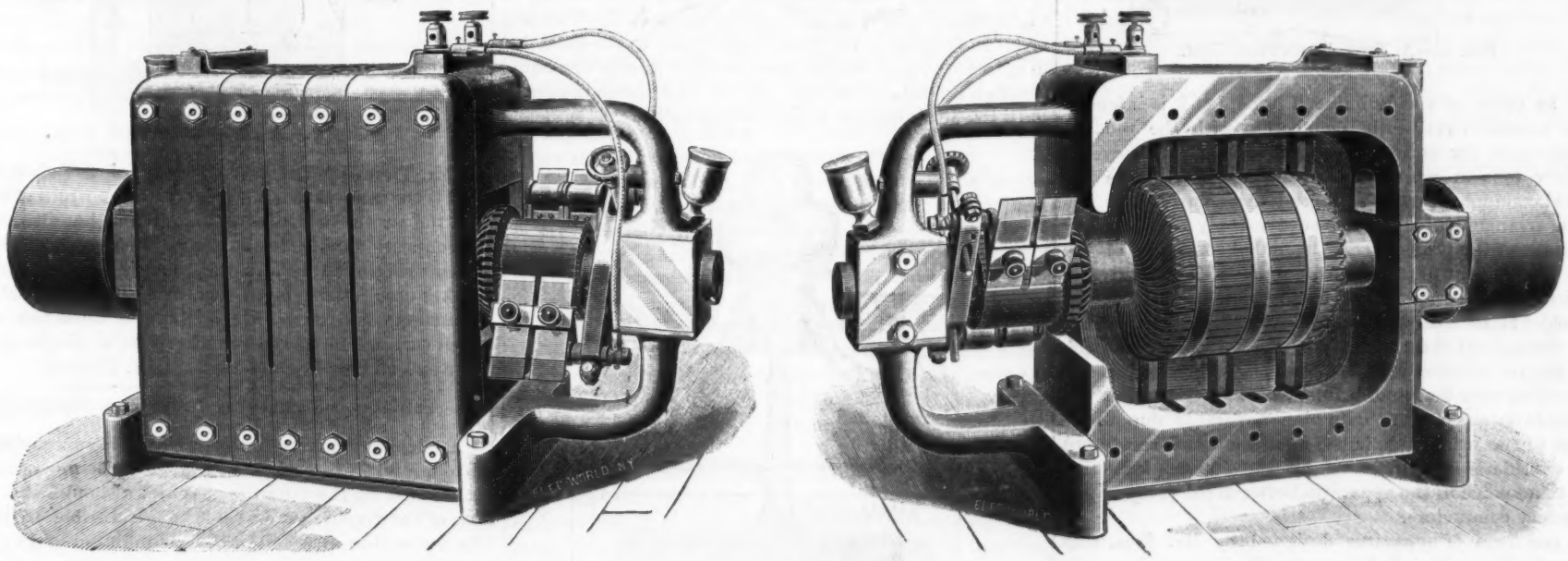
The largest armature so far wound in this way was for the Field electric motor. The core of this armature is 40 inches long and 22¼ inches in diameter. The wire was divided into 104 sections, with 8 complete turns in each section. No. 7 B. & S. double covered cotton insulated wire was used, and all of the sections were separately wound, shellacked and dried before being placed on the core. In this armature the wire required a space of but 3 inches along the shaft at each end of the core.

The armature with the greatest number of turns yet wound in this way has a core 12½ inches in diameter and 18¾ inches long. This is wound with 1,728 turns of No. 18 B. & S. wire. There are 72 sections, with 24 turns in each section. This wire increased the length of the drum by only 1¾ inches at each end.

Armatures have thus been made varying in length of core from 1½ to 40 inches, and in diameter of core from 2 to 22¼ inches; in number of turns per section from 2 to 24, and using wire from No. 4 to No. 25 B. & S. Hence sufficient experience has now been obtained with this new method of winding armatures to warrant the statement of the inventor that an armature of any size whatever can be made in this way, with any desired size of wire, and in sections of any desired number of turns; and in each case by finishing the sections separately before putting them on the core.

It will be apparent that an armature wound in this way has its sections of exactly the same resistance, and symmetrically disposed over the surface of the core, thus removing the chief causes for sparking at the brushes. And also that this method furnishes ready means for obtaining the highest possible insulation between the wires of the same and neighboring sections.

The winding frame in which the armature coils are made is so simple that both less skill and time are required to make an armature in this way than in the ordinary manner. The design of the new machine is mechanically simple and durable, so that it can be easily taken apart and assembled again, and the running parts are perfectly balanced. Ample space is allowed about the coil to provide for good ventilation by the currents of air forced through the machine by the revolving armature. Several machines of this new type are already in use, and are reported to give very satisfactory results. We may add that one of these machines may be seen in operation at the works of Messrs. J. H. Bunnell & Co., of this city, who are also the selling agents for the machine.



FIGS. 1 AND 2.—THE EICKEMEYER DYNAMO.

Execution by Electricity.—The bill introduced in the New York State Assembly establishing electricity as a means of execution in capital sentences as recommended by the recent special commission has been adopted by an overwhelming vote.

Conductivity of Nitric Acid.

It has been shown by M. Bouty that the addition to fuming nitric acid of very minute proportions of an alkaline nitrate has the effect of considerably augmenting the electrical conductivity of the liquid. Continuing his researches in this direction, the same investigator points out that, up to a certain point, the addition of water to the concentrated acid increases its conductivity almost in the proportion of the quantity of water added. The addition of small proportions of dehydrating substances, such as concentrated sulphuric acid or anhydrous sulphurous acid, has the same effect, apparently by reason of the production of electrolytic compounds of sulphuric or phosphoric and nitric acids. Lastly, M. Bouty has demonstrated that nitric acid in different stages of dilution does not contain the same electrolyte.

A New Form of Induction Coil.

Inductional transformers or convertors are now receiving such widespread attention in electrical circles, in connection with the distribution of electricity by means of high tension alternating currents, that any new design in the construction of such apparatus awakens interest in spite of the fact that quite a number of forms are already in existence.

In the new type of transformer designed by Mr. Elias E. Ries, of Baltimore, Md., the high tension primary wire is completely inclosed within and protected by the low tension secondary, the two forming a single compound conductor. By virtue of this ingenious arrangement, a number of important results are claimed to be obtained both in the construction and operation of the apparatus.

In the accompanying engravings Fig. 1 shows a compact and simple form of cylindrical transformer wound with the compound conductor, and Fig. 2 shows an enlarged sectional view illustrating the method of connecting the end turns of successive layers of the compound winding to permit of grouping the low tension of secondary conductor into one or more parallel sets. Fig. 3 is an elevation and section of the combined primary and secondary conductor.

As will be seen the inductional conductor shown in Fig. 3 is applicable to the ordinary form of induction coils,

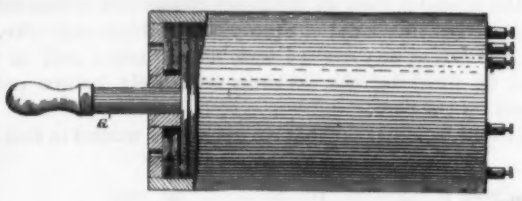


Fig. 1.—A New Induction Coil.

such as those of the Ruhmkorff type, but it is intended more especially for use in connection with the modern transformers for converting high tension line currents into low tension working currents. In either case the central conductor carries the high tension current.

This arrangement is said to insure not only greater safety by reason of the protected and insulated condition of the high tension central conductor, but also a high degree of efficiency in conversion due to the absolute parallelism and close relationship of the primary and secondary windings throughout their entire length. Moreover, as each unit length of secondary wire completely surrounds a corresponding unit length of primary or inducing wire, the available output of the induction apparatus due to the action of the primary impulses upon the core is reinforced and considerably augmented by the direct induction that takes place in the apparatus between the primary and secondary conductors.

In one form of apparatus designed by Mr. Ries, that shown in Figs. 1 and 2, the conductor is wound upon a tubular soft iron core, having end flanges of the same metal, and a threaded cylindrical inclosing case arranged to screw over the end flanges and serving to complete the magnetic circuit. A supplemental laminated central core G is also provided, by means of which the magnetic saturation of the transformer can be varied to suit different requirements. In order to adapt the transformer to such cases where the required translation cannot be effected alone by the difference in sectional area or conductivity of the two conductors, a slotted disc f of insulating material is slipped over the core B near one end, and over this disc is passed the end turn of each layer of the compound winding. The insulation is then removed from the exterior low-tension conductor at these points, and connection made therewith by means of binding posts, whereby the several secondary layers may be connected in parallel, which is equivalent to reducing the number of secondary convolutions and diminishing their total resistance. In this manner any desired electromotive force may be obtained in the secondary circuit from a given primary E. M. F.

It will be observed that reducing the number of secondary convolutions by grouping them in parallel does not interfere with the number of primary turns in circuit, and that each unit length of primary wire is still as effective with regard to the secondary as before. It is also evident that the compound or duplex wire is applicable to any of the well-known types of transformers, and is said in the majority of cases to very materially simplify the operation of the winding. In the particular form of apparatus illustrated, no special provision is made for laminating the core and its inclosing shell, and for ventilation, although in a slightly modified apparatus, Mr. Ries has introduced these features. The compound conductor can also be used to advantage for winding "motor-generators" or continuous current transformers,

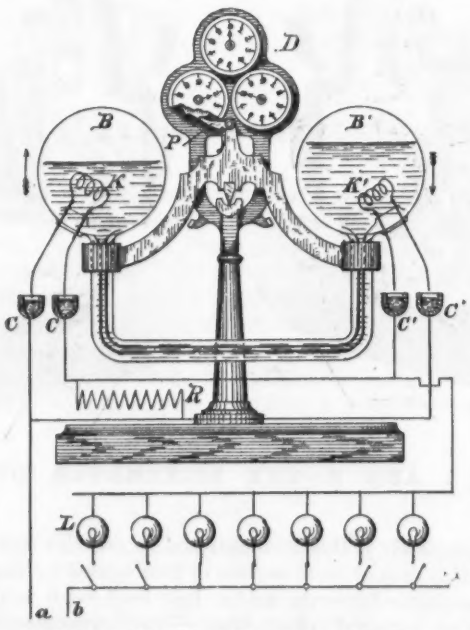
Thomson's Electric Meter.

For the purpose of obtaining a meter which shall register the amount of current, either continuous or alternating, passing through a circuit, Prof. Elihu Thomson has recently constructed an ingenious form of meter in which the heating property of the current is employed as a means of effecting motion in a registering train. The accompanying illustration shows one form of the apparatus designed by Professor Thomson. It consists essen-

Fig. 3.—A New Induction Coil.

tially of two bulbs B B' attached to each other by a tube T, of narrow bore, or so arranged as to resist the rapid flow of liquid throught it. Two small resistances K K' are sealed into the bulbs which are partly filled with alcohol, which is boiled, and the whole is sealed when the alcohol vapor has completely filled the interior space.

At the top of the central pillar is a knife edge support which carries the frame F F to which the bulbs and tube are attached. The suspension is so arranged that the centre of gravity is above the point of support, so that the arrangement is in unstable equilibrium. Thus it cannot rest in a middle position, but tips either way according to the excess of weight on either side. Mercury cups C C and C' C' receive alternately the ends of the wires leading to the coils K K', in accordance with the position of the bulbs, so that when B is down the coil K is in circuit, and the coil K' out of circuit, and *vice versa*. While the wires dipping into the cups C C may be arranged so as to make contact just before the others in C' C' break their contact, this need not be the condition, for, by interposing a resistance R, as a bridge, the circuit is maintained even though a break should occur between C C and C' C'. The operation of the apparatus will now be readily understood. Assuming the bulb B to be depressed, so that its heating coil K is in circuit, if a certain number of lamps L be fed by a current, the coil K will be fed by a definite proportion of it, and will cause a slight warming of it in the liquid in the bulb B. This will result in depressing the level of the liquid in the bulb, due to increased vapor tension and a resisted flow of the liquid through the tube T into the bulb B'. This action continues until the accumulated weight in the bulb B' is sufficient



Thomson's New Electric Meter.

to tip the apparatus over and connect the coil K' instead of the coil K in circuit. The reverse action now takes place, resulting in a depression of the level in the bulb B' and an elevation of that in bulb B, until an overbalance is reached, when the arm is again tilted, and so on. At each complete oscillation the pawl P moves the register and counts a definite amount of current consumed.

The Conductivity of Boiling Sulphur.

M. Duter contributes to the *Comptes Rendus* a note in which he describes some experiments undertaken in order to see whether a current could be made to pass through sulphur maintained at the boiling point. He found that electrodes of platinum were attacked, and it was therefore necessary to use pure gold. By the aid of a copper voltameter placed in series he measured the number of coulombs passed through by means of a Ruhmkorff coil and a set of Leyden jars. At the end of eight hours he found that the increase of weight of the copper cathode was equivalent to the passage of a current of 0.0008 ampère. The specific resistance was not, however, ascertained.

The Electric Lighting of Trains.

Amongst the many systems that have been proposed from time to time for the lighting of railway carriages by electricity, a prominent place must be accorded, says *Engineering*, to that introduced by Mr. I. A. Timmis, of London, as the result of some years' experience in this class of work. The central idea of Mr. Timmis's plans is, that any accident to the train destroying its continuity or otherwise injuring the charging circuit, shall light the lamps. To do this it is necessary that each carriage shall be provided with a storage battery, which the inventor of the system places under the carriage, cells of the Union type being employed, as these are—owing to the use of lithanode plates—less liable to sulphating than cells of the Planté or Faure type. This battery is connected to the lamps through two switches, one of which is operated by hand and the other by an electro-magnet which opens the switch, breaking the circuit when a current is passed through its coils. This current passes along the same negative main as the charging and lamp circuits, but is provided with a distinct positive lead running, like the negative, the whole length of the train, but broken by a switch in the guard's van, by the closing of which the whole of the lights will be extinguished. To light the train it is only necessary to interrupt this circuit, either by opening the switch in the guard's van, or by otherwise destroying the continuity of the conductor, as by the train parting in two, in which case the magnets will cease to act and the switches on the lamp circuits controlled by them will be closed by the springs with which they are fitted. The charging of the batteries is done either by a dynamo in the guard's van driven by a belt off the axle of one of the wheels, or by a dynamo and separate engine fitted on the locomotive, the latter being the arrangement preferred

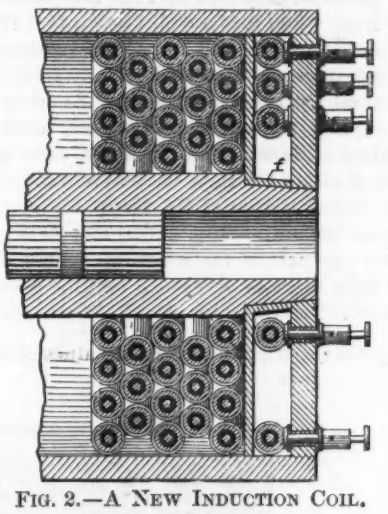


Fig. 2.—A New Induction Coil.

by Mr. Timmis. The negative lead of the charging circuit is the same as that of the lamp and controlling circuits, but the positive is distinct. Mr. Timmis has also arranged in connection with his lighting system a communication circuit ringing a bell in the guard's van, which again makes use of the general negative lead, but as before has a distinct positive one. The coupling of these four circuits from carriage to carriage is effected at a single operation by a special coupling designed by Mr. Timmis.

Telephone Signals in Submarine Telegraphy.

A telephone, placed in the circuit of a submarine cable through which the ordinary signals are being transmitted, is affected by the currents passing; although the vibrating of the diaphragm may not be perceptible to the ear, for the well-known reason that a minimum of twenty vibrations per second is requisite to produce an audible sound. But if an interrupter, breaking the current more than twenty times per second, be also inserted in the circuit, an undulating sound is conveyed to the ear by the telephone. On this principle, M. Ader has constructed an apparatus which allows of the employment of phonetic signals in submarine telegraphy.

Thomson's Electrometers.

To the Editor of The Electrical World:

Sir: Will you when convenient publish in the World a description and analysis of Thomson's electrometers? I refer to the attracted disc form and to both the idiostatic and heterostatic methods. B. C. W.

Answer.—You will find descriptions of this apparatus in most text-books. Gordon's *Electricity and Magnetism* especially giving a clear explanation, with numerous illustrations.—Eds. E. W.

The Gas Evolved from Storage Batteries.

To the Editor of The Electrical World:

Sir: Will you kindly inform me through your valuable paper whether the gas which is given off by storage batteries while charging is injurious to health, and if so, to what extent? C. W. S.

Answer.—This gas in itself is injurious to health, affecting the lungs. But if the space in which the batteries are situated is well ventilated no danger need be apprehended.—Eds. E. W.

A Practical Method of Calculating and Designing Dynamos and Motors.*

BY FRANCIS B. CROCKER.

It has happened that a large part of my work for the last three or four years has involved the designing and calculating of the proportions and constants of dynamos and motors, and I have naturally collected a number of methods and ideas relating to this subject which may be interesting and useful to others working in the same field. The methods and views which have been selected are those which I have found by experience to be the simplest and most generally applicable and, at the same time, more than sufficiently accurate for most practical purposes.

Almost every one interested in electricity has *seen* the articles by Hopkinson, Kapp and others, usually entitled the "Predetermination of the Characteristics of Dynamos." These papers are certainly very able and complete as mathematical feats, but I will venture to say that very few ever actually *read* those articles through, and still fewer persons understand them. This is a fact, not because there are not a great many who are perfectly capable of understanding such articles, but because the latter are so long and complicated and so bristle with Greek letters and the calculus that they are very uninviting to say the least, and ninety-nine readers in a hundred turn to more attractive parts of the book or paper.

In comparison with such elaborate mathematical structures my methods seem very thin and transparent. But as most of us have neither the time nor inclination to use the complicated methods, and as articles and books generally treat the subject in that way, I think a little time may be spent profitably upon the simpler methods even though some of them may be known to you already.

General Principles.—In the first place let us consider briefly how a dynamo generates electric current and how a motor develops mechanical power. There are various ways of looking at the generation of current in dynamos, the ordinary one being the cutting of magnetic lines of force by an electric conductor. This view is very satisfactory in most cases, but I think it is very often too narrowly considered. For instance, take the old-fashioned Siemens I armature. There is no cutting of lines of force in the ordinary sense, the conductors are not really in the magnetic field at all; they first *surround the lines of force, then loose them, then surround them again in the opposite direction*, and so on. I think the best way is to consider the conductors as cutting so many lines of force, which also means inclosing so many lines of force, which alternate or change in intensity so many times per second. In describing the calculations of E. M. F. I will treat this subject further and give the actual values of the different quantities involved.

Development of Power by Motors.—An electric motor develops mechanical power in exactly the opposite manner to the generation of current by a dynamo. In a dynamo,

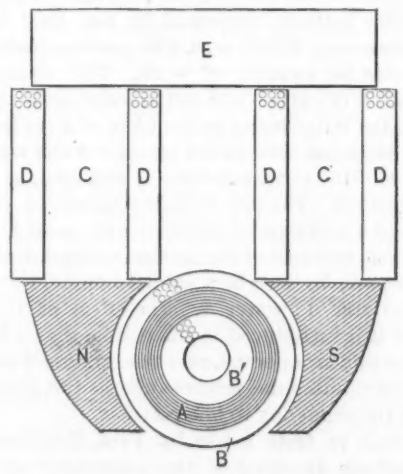


FIG. 3.—METHODS OF MOTOR CONSTRUCTION.

as we have just seen, the conductor is made to revolve in a magnetic field, and the current is produced in that conductor.

In a motor a conductor carrying a current and placed in a magnetic field is caused to revolve by the action of the magnetic field upon the current. In short a dynamo is a perfectly reversible machine, capable of converting mechanical power into electric current, or electric current into mechanical power, just as the use to which it is to be put requires. Identically the same machine can be used for both purposes, and except for the mere question of detail and convenience, there is no necessity whatever for even modifying the design of the machine to apply it to one purpose or the other. A few years ago it was not generally admitted that the best dynamo is the best motor, but now I think this fact is generally recognized. The experiments of Hopkinson and others on the efficiencies of identical dynamos and motors gave substantially the same results for both.

I will now take up and consider separately the parts of dynamos and motors.

The Armature.—The armature is the most important element of the machine, and is by far the most difficult to correctly design and properly construct.

There are two general types of armatures, the "ring" and the "drum." The ordinary Gramme ring is the best and simplest example of the ring armature, and I have always found, in studying or explaining a dynamo or motor, that this form of armature is more easily understood, and the magnetic and electric actions which take place are more apparent. The general principle of the construction of the Gramme ring is illustrated in Fig. 1, in which *A* is the armature core and *B* the winding. The advantages of the Gramme ring are: First, the diameter can be increased indefinitely without necessarily increasing the length of each convolution; and for most purposes a large diameter of armature is, in my opinion, very desirable. Secondly, the convolutions forming the winding of a Gramme ring do not cross each other, and, consequently, there is less liability to short circuits. The disadvantages of the Gramme ring are: First, the crowding together of the wire on the inside of the ring, owing

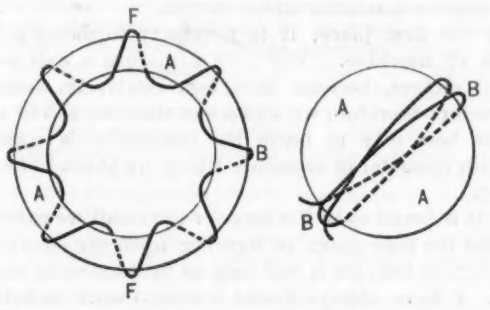


FIG. 1 AND 2.—METHODS OF MOTOR CONSTRUCTION.

to the fact that the inside circumference is, of course, less than the outside; and secondly, the mechanical difficulty of carrying or supporting the wire, due to the fact that the wire is interposed between the iron ring and the shaft.

The ordinary form of drum armature is the Siemens, the general principle of which is shown in Fig. 2, and which is the type most generally adopted by the best makers of dynamos at the present time. For the sake of simplicity, only two convolutions of winding are represented. The advantage of the Siemens armature is its solid mechanical construction, the iron armature core being mounted directly upon the shaft. The disadvantages are: First, the small diameter which we are obliged to use in order not to increase the length of the wire across the ends, which is usually considered to be dead or useless wire. Secondly, the piling up of wire on the ends where the convolutions cross each other. There are, of course, various forms of armatures, and some which do not even come under the two classes which I have spoken of, but it would only confuse the subject to attempt to consider all the forms, and if the two most typical and common forms are clearly understood, it is a comparatively easy matter to apply the principles to any other machine.

Electromotive Force.—The electromotive force which a given armature is capable of developing may be calculated or pre-determined without trying it experimentally. It may also, of course, be tested by actual trial in various ways. There are also several different ways of calculating the electromotive force. These are generally overcomplicated and abstruse, and is the most difficult part of the mathematical analysis of dynamos, of which I have already spoken. A very simple method of calculating the E. M. F. in any given case, and one which I have found to give excellent results in a number of cases, is as follows:

Let us take a typical machine, such as is shown in Fig. 3, for example, in which *A* is the armature core, *B* the exterior and *B′* the interior portion of the winding, *N* and *S* the pole pieces, *C C* the field magnet, *D D* the field magnet coils or winding and *E* the yoke. Assuming the radial thickness of the ring to be 1 inch, and its length, parallel with the shaft, to be 3 inches, then the cross section of one side of the ring will be 3 square inches. Now, in calculating the E. M. F. we can only take one side of the ring, because the two sides are in multiple arc and do not add their E. M. F. to each other, but merely unite and flow out together at the brushes. I have found by repeated experiments that *each convolution generates from* $\frac{3}{100}$ *to* $\frac{4}{100}$ *of a volt per square inch of armature core, with* 1,000 *reversals per minute.* This is entirely independent of the length of the convolution. The outer convolution generates no more E. M. F. than the inner; the area of the core alone determines the E. M. F. produced. If we double this area we double the E. M. F., other things being equal.

I assume 1,000 reversals per minute as a standard case; it is easy to remember, and it is not very far removed from the number which actually takes place in practice. One thousand reversals is equal to 500 revolutions in a 2-pole machine, because in one revolution the armature core passes once under the north pole and once under the south pole.

I use the term "reversals" instead of "revolutions" because it is general. For example, in a multipolar machine of 4 poles there would be four reversals per revolution. Now, in the machine we are considering there are 3 square inches of armature core on each side, and assuming 1,500 revolutions per minute, or 3,000 reversals, and assuming 300 convolutions of wire *on each half* of the ring, we will have: $\frac{3}{100}$ (volt) $\times$ 3 (sq. in.) $\times \frac{3,000}{1,000}$ (reversals) $\times$ 300 (convolutions); or, $\frac{3}{100} \times 3 \times 3 \times 300 = 81$ volts as the E. M. F. produced in this particular case. I assume, of course, that the armature core is saturated, or nearly saturated, magnetically. If it is only half saturated then the E. M. F. will only be one-half of 81 volts.

In the case of the Siemens armature, the cross section to be used in this calculation is the full cross section of the armature core, because each convolution passes entirely round the core. Therefore, if we have a core 5 inches in diameter and 8 inches long, we will have 40 square inches of cross section; but, as in the case of the Gramme ring, we must use only half the convolutions in the calculation, because the two halves of the winding generate E. M. F.'s in multiple arc with each other and not in series. In a precisely similar manner we may calculate the E. M. F. in any machine by simply *multiplying* $\frac{3}{100}$ *(volt) by the cross section of the armature core in square inches, and by the number of convolutions in series with each other, and by the number of times that* 1,000 *reversals occur in one minute.*

Field Magnets.—In designing the field magnet of a machine the first question to decide is the material out of which it is to be made. The latest data I have seen give the relative magnetic permeability or magnetic conducting power of different irons as follows: Cast iron, 10; malleable cast iron, 12; best wrought iron, 18. We see therefore that wrought iron is decidedly better than either cast or malleable cast; but in some cases considerations of cheapness or peculiarities of form may make cast iron preferable. Whenever cast iron is used in place of wrought, the cross section of the cast iron should be increased in proportion to its lower magnetic conducting power, *i. e.* any cast iron portion or portions of a magnetic circuit should be made at least 1½ times as large as the wrought iron portions of the same circuit. The second consideration in designing the field magnet is to make the magnetic circuit as short as possible; *i. e.*, the cores should be made no longer than is absolutely necessary to get the required amount of wire on them.

The pole pieces should generally be made larger than the field cores, particularly if they are of cast iron. By making the pole pieces larger in cross section and covering more of the surface of the armature than the area of the cross section of the core, we reduce somewhat the magnetic resistance of the circuit, and in most cases there is no objection to this increase in size. I do not believe, however, in covering too much of the armature with the pole pieces, because if the extremities of the pole pieces are brought close together there is leakage across between them. Furthermore the neutral zone, where there are no magnetic lines of force passing into the armature, is reduced, and it becomes just so much more difficult to set and keep the brushes at the neutral point. Each pole piece should cover, in ordinary cases, from ¼ to $\frac{3}{10}$ of the armature.

The proportion between the cross section of the field

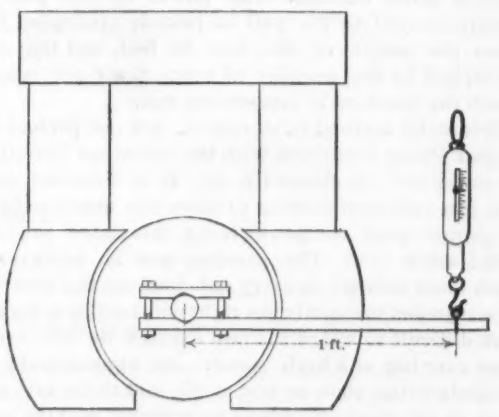


FIG. 4.—METHODS OF MOTOR CONSTRUCTION.

core and that of the armature core as given by Hopkinson, Dugald Jackson and others, and which agrees with my own experience, is that the latter to be 75 or 80 per cent. of the former; or in other words, the cross section of the field core should be ⅓ or ¼ greater than that of the armature core, assuming them both to be made of the same material. If the field core be made of cast iron and the armature core of wrought iron, then the field should be at least twice the area of the armature core.

The field winding required to obtain magnetic saturation or to fully charge the magnets depends somewhat upon the kind of iron and other conditions, but I have found that it is affected very greatly by the distance between the pole pieces and the armature core, or what I call the magnetic "jumping space," that is, where the magnetism passes through the air which is of very great magnetic resistance. If this space between iron and iron is ¼ inch, it takes about 1,000 ampère-feet per square inch cross section of field core to saturate it; if the space is ½ inch it takes about 700,

You will notice that I speak of ampère-feet instead of ampère-turns, the term ordinarily used. I do this because I have found that ampère-feet apply to any size of mag-

* A paper read before the New York Electrical Society

net, whereas the ampère-turns vary very greatly with different sizes of magnets. It must be obvious to any one that an ampère-turn in the case of a magnet 1 inch in diameter will not produce the same number of magnetic units that an ampère-turn will in the case of a magnet 1 foot in diameter; whereas a given number of ampère-feet will always produce the same magnetic effect, whether they surround a 1-inch core or a 1-foot core; provided, of course, the saturation point is not passed. To test the universal application of ampère-feet, I applied it first to the case of a ¼ h. p. motor, and then to a 500-light dynamo, both of which worked at the saturation point, and I found that precisely the same number of ampère-feet are required per square inch of cross section of field core in the one case as in the other. I have also applied it to intermediate cases, and it holds goods with sufficient closeness in all cases that I have come across. I should say, however, that I have not applied it to the case of cast iron magnets, and therefore cannot speak positively about them; but I suppose it would apply to them also, allowance being made for the different magnetic permeability.

Current Capacity.—The amount of current which a given size wire is capable of carrying is, I think, one of the most important questions involved in the designing and calculating of electrical machines. It is not, however, by any means a difficult mathematical problem to solve. The simple rule is that a good copper conductor should have a cross section of from 600 to 1,000 circular mils per ampère of current carried. The circular mils are simply the square of the diameter of the conductor in thousandths of an inch. The carrying capacity depends, of course, upon the conditions in each particular case. If the conductor is so situated that it may readily lose the heat produced in it by the current its carrying capacity is increased. A single wire exposed to the air will carry, without overheating, much more current than a mass of conductors lying close together. This applies to thickness of winding. A field magnet coil, for example, should preferably be not more than one or two inches thick. If thicker than this, the heat is apt to accumulate very objectionably. Other things being equal, a small wire will carry relatively more current than a large one, because its radiating surface, as compared with its mass, is greater than in the case of a thick wire. If conductors are always made at least 800 to 1,000 circ. mils per ampère, they will be right in ninety-nine cases out of a hundred. The error should be made on the safe side.

Power.—The power of a motor or output of a dynamo may be determined by calculating the E. M. F. and current capacity separately by means of the rules explained above, and multiplying the two together; the product will be the power in watts. The horse-power is found by dividing the number of watts by 746.

A static method of testing the power of a dynamo or motor is represented in Fig. 4. It consists in clamping an arm upon the shaft of the machine so that it cannot turn, and then weighing the pull which the armature exerts with a given current. The power in foot pounds per minute is equal to the pull in pounds multiplied by 6.28, times the length of the arm in feet, and that product multiplied by the number of revolutions per minute at which the machine is intended to run.

This static method is, of course, not as perfect as the regular Prony brake test with the armature running. In the brake test the clamp (in Fig. 4) is loosened so as to give just sufficient friction to allow the machine to run at the proper speed, the power being calculated precisely as in the static test. The running test is, however, very much more difficult to carry out, because the friction has to be adjusted to exactly the right point and it is very much more difficult to weigh the pull exerted by the armature when running at a high speed. An approximate test is infinitely better than no test at all, and there are a great many cases where one would go without making any test rather than try a running one; whereas the static way is so simple and short and requires so little adjustment that one is not so likely to shirk it.

As a matter of fact the static method is quite accurate for machines of high efficiency, because in a really good machine of say 90 per cent. efficiency all the losses together are not over 10 per cent.; and the Foucault currents and resistance of air, which are the only losses which cannot be tested statically, are only a portion of this 10 per cent., say, half of it, and, therefore, do not affect the result very greatly. In fact, by allowing 5 or 6 per cent. for these two items the results will be almost perfectly accurate in most cases. I am, of course, here only considering the testing of a machine at or near its full power; if it be tested statically at low powers, the errors will be increased proportionally. But certainly the results at full power are really those which it is most important to know Any machine which is so inefficient that this method does not apply to it, is so poor that it ought not to be built at all. The time for inefficient and improperly designed and constructed machines has gone by.

This same static method of testing power which I have just described enables us also to determine the counter E. M. F. of a motor or the direct E. M. F. of a dynamo running at a given speed. The same arrangement shown in Fig. 4 is used, and the pull exerted by the armature with a given current passing through it is weighed as before. We have:

E. M. F. × *current* × 44¼ = 6.28 × *rad.* × *Pull* × *Rev.*

E. M. F. is expressed in volts; *current*, in ampères.

1 watt = 44¼ ft. pounds per minute.

6.28 = circumference of circle when radius = 1.

Rad. = radius in feet; *Pull* = pull in pounds.

Rev. = revolutions per min.

Assuming E. M. F. = 1 volt and *rad.* = 1 ft. the equation becomes:

$$Rev. = \frac{7.04 \times ampères.}{Pull.}$$

That is, the revolutions per minute required to give 1 volt are equal to seven times the ampères in the armature, divided by the pull in pounds at 1 foot from the centre.

Let us now apply the foregoing methods to an actual example.

Example: Let it be required to design a series wound motor to give 1 h. p. at 1,500 revolutions per minute on a ten ampère constant current circuit.

In the first place, it is necessary to choose a certain form of machine. The ring armature is well suited to small motors, because it is not, relatively, so small in diameter; therefore we will select that one as our type.

The best way to begin the calculation is to assume a certain diameter of armature which we think to be about right.

If it is found to be too large or too small we can change it, and the time spent in figuring upon the incorrect size will not be lost, for it will help us in calculating the right size. I have always found it well to work on both sides of the correct size in order to be surer of not making a mistake, and to see the effect of changing the different dimensions.

Armature: Assuming a ring armature 6 inches in diameter when completed, and allowing ½ inch on each side for winding, the iron core will be 5 inches in diameter. Since the winding is ½ inch thickness on the outside of the ring, it will be about twice as thick on the inside, owing to the smaller circumference; and allowing 1½ inches for the shaft, etc., we find that the inside diameter of the iron core must be made 1 + 1 + 1½ = 3½ inches. Therefore the radial thickness of the iron ring *A* (Fig. 3), will be ¾ inch (on each side), since 3½ + ¾ + ¾ = 5. Assuming that the iron core is 2½ inches long, the cross section of each side of the ring will be 2½ × ¾ = 1⅞ sq. inches. The iron ring being 5 inches in diameter, the half circumference will be very nearly 8 inches.

A New Primary Battery.

Since the motor is to run on a 10 ampère circuit, each half of the armature winding will have to carry 5 ampères, since in the Gramme armature the current divides into two parts. It has been stated above that 800 circ. mils per ampère is a good figure, therefore, the size of the wire should be 5 × 800 = 4,000 circ. mils. Referring to a table of wire gauges we find No. 14 B. & S. = 4,106 circ. mils. which we take. No. 14 wire is .064 in diameter naked, and allowing .012 for insulation (average allowance) we have .076 as total diameter. Therefore No. 14 will lay 13 to the inch (13 × .076 = .988).

Again, since the half circumference equals 8 inches, one layer will require 8 × 13 = 104 convolutions; and as we have ½ inch space for winding we can have 5 layers = 520 convolutions, and still space enough for clearance Each convolution is about 7 inches long (2½ + 1 + 2½ + 1), making 300 feet of wire, weighing, according to wire table, 5 pounds, on *each half* of armature, or 10 pounds of wire in all.

We have seen above that the volts produced by a machine = .035 × cross section × convolutions × $\frac{\text{No. of reversals}}{1{,}000}$. Substituting the values we have in this particular case, $.035 \times 1\frac{7}{8} \times 520 \times \frac{3{,}000}{1{,}000} = 102.3$ volts. That is to say, the counter E. M. F. developed by this motor running at 1,500 revolutions per minute will be 102.3 volts. I use .035 in this case because it is an average value, but, probably, .03, which I used before, is a surer and safer figure.

Field Magnet Cores.—The cross section of each side of the armature core we have determined to be 1⅞ sq. inches, and both sides added would be 3¾ sq. inches. Therefore the field magnet will have to be sufficiently large to fully saturate this area; or, as has already been stated, about 25 per cent. greater, which would make it 4¾ sq. inches very nearly. The diameter of core corresponding to this cross section is 2½ inches. This is the proper diameter for a wrought-iron core; for cast-iron it should be about 70 per cent. greater cross section, or 3½ inches in diameter. The yoke should be made at least equally large.

Field Magnet Winding.—Since the field winding carries the whole current of 10 ampères it should be of about 10 × 800 = 8,000 circ. mils. = No. 11 wire. In the case of the field winding a size larger, No. 10, is safer and better. The length of wire required to obtain saturation with a distance of ¼ inch between the pole piece and armature core is 1,000 ampère feet per square inch area. In this case the field core is 4¾ square inches in section. Therefore, we shall need 4,750, say 5,000 ampère feet; and since the current is 10 ampères the necessary length of wire is 500 feet, including *both* cores, weighing about 20 pounds insulated. The cores are 2½ inches in diameter, or about 8 inches in circumference; therefore, there will be $\frac{12 \times 500}{8} = 750$ convolutions, or 375 on each core. (The number 12 in the equation stands for the number of inches in a foot.) Each convolution occupies ¼ inch and, assuming the cores to be 7 inches long, each layer will have 56 turns and there will be 7 layers.

The resistance of 500 feet of No. 10 wire, according to wire table, is ¼ ohm; and therefore the fall of potential in the field winding with 10 ampères, will be 5 volts, according to Ohm's law.

We have calculated that the armature will have two circuits, each consisting of 300 feet of No. 14 wire. The resistance of one of these is .8 ohm, and of two in multiple arc, as is the case here, is .4 ohm; consequently the fall of potential due to the resistance of the armature is 4 volts.

The counter E. M. F. has already been found to be 102.3 volts; adding to this the drop of 5 volts in field and 4 volts in armature, we have 111.3 volts as the total E. M. F. required to be supplied to the motor, which, multiplied by 10 (ampères) gives 1,113 watts as the total electrical power absorbed by it.

The net commercial efficiency of such a motor should be 75 per cent., hence the actual mechanical power developed will be equivalent to .75 × 1113 = 834 watts; and allowing 10 per cent. more as a margin we have 750 watts, or 1 h. p., almost exactly, as the true working power of this motor.

In the same way and using exactly the same data and principles, any other motor or dynamo may be designed and its proportions and constants predetermined.

I have assumed throughout the above that the materials and construction are good. The wrought iron, copper wire, etc., should, of course, be of good quality. The armature core should be made up of laminæ of soft sheet iron separated by tissue paper or other insulator, and the shaft, bearings and other mechanical parts should be large enough and properly made. Otherwise the machine will not come out as it should.

A New Dry Battery.

Our attention has recently been called to a form of open circuit "dry battery," invented by Dr. Carl Gassner, of Mentz, Germany, which is said to possess qualities which give it value for a variety of work. The elements of the cell are a rod of carbon and manganese molded together, and zinc, the latter being in the form of a cylinder which serves at the same time as the casing for the whole and to which one of the terminal wires is attached, as shown in the illustration. The cell contains an active material in the form of a paste and is hermetically sealed. This active material consists of the following ingredients: Oxide of zinc, 1 part, by weight; sal-ammoniac, 1; plaster, 3; chloride of zinc, 1; water. 2. The effect of the oxide of zinc after it is introduced in the cell is, that it loosens and makes the mixture porous, and the greater porosity thus obtained facilitates the interchange of the gases and diminishes the tendency to polarization.

According to tests made by Prof. Eric Gerard at the Electrotechnic Institute of the University of Liége, the first form of battery had an E. M. F. of 1.311 volts on open circuit, and an internal resistance of .70 ohm. An improved form has an E. M. F. of 1.44 volts, and an internal resistance of 0.32 ohm.

We may add that this cell is now being introduced by Mr. A. Schoverling, of this city.

Static Electricity and Incandescent Lamps.

To the Editor of The Electrical World:

Sir: Reading the communication from "L. S. D." in your issue of April 7, on the effects of static electricity on incandescent lamps, recalls an experiment I made with some incandescent lamps by holding them to a fast running belt and charging them. I held one quite close to the belt for a considerable length of time, when suddenly a charge pierced the globe and I experienced the same electric shock as did L. S. D. But he states that the shock and the light were of short duration, whereas in my experience the lamp continued to glow for a considerable length of time and showed the form of the carbon very beautifully. By holding the lamp between the palms of both hands, it would continue to brighten and die away alternately.

I tried the experiment with an Edison lamp but the glow was hardly perceptible and lasted only an instant.

Jersey City, N. J. W. W. K.

Discussion on the Maximum Efficiency of Incandescent Lamps.

The following is an abstract of the discussion of Mr. John W. Howell's paper, read before the American Institute of Electrical Engineers on April 10.

Mr. S. S. WHEELER: I am glad that Mr. Howell has given us the result of these experiments without any attempt to alter them, because I think that when slight variations are seen in experiments we have greater faith in their accuracy. I understand that the curve of minimum total cost represents the mathematical sum of two other curves, viz., the curve of cost of the lamps and the curve of cost of power. The curve of cost of lamp is there on the chart, and I would like very much to see the curve of cost of electricity. As I understand, it is a straight line.

Mr. Howell laid out the points on the chart, and the resultant proved to be a straight line.

Mr. WIRT: It happens sometimes that power may be increased at very little additional cost. Thus, say, you are using one hundred ampères, and to get the cost of an ampère you divide the total cost by one hundred; that gives you ten cents an hour. But you can furnish a few additional horse-power at very slight increase of cost.

Mr. HOWELL: Of course in any case like that your figuring would not amount to much. I do not suppose any calculations of that kind are much good, unless you apply them on a very large scale. Suppose we know from our records of a station for a whole year the total expenses for that year, the differences between that and the lamp bills will show the total cost of current. We have also got to know, besides the total expenses, the current produced, the average per month or the average per year. Of course if you applied that to any given time or any short time, you would find one day very different from another, and you would have to change your lamps every day.

Mr. CROCKER: I would like to ask Mr. Howell if he thinks those maximum points in the curves could be varied slightly, so as to have the lamps break less frequently. I think almost every customer would like to increase the life of his lamps, even though he had to pay more for his current. Do you not practically consider such points as that?

Mr. HOWELL: In any such case the only way you can allow for that on a curve is to get a money value for a man's invenience.

Mr. C. O. MAILLOUX: I would like to ask Mr. Howell whether the life of the lamp, as it is taken in these curves, means the time at which they break or the time at which they become so dark that they no longer give the same candle-power.

Mr. HOWELL: The life in all lamps is taken on a new lamp. You cannot get a law, if you consider some new, some old, and some three-quarters old. Of course the easiest way is to take the one of least trouble; that is, the new lamp. It makes no difference at which point you compare the lamps as long as you compare them all at the same point.

Mr. MAILLOUX: It occurred to me, on looking at a lamp as one of those things which is constantly varying in its light-giving power, that it would react somewhat on that part of the curve which refers to the cost of lamps, because certainly a lamp of low efficiency would, other things being equal, be preferable, from the fact that it would have a more uniform candle-power and would last longer.

Mr. F. UPTON: The assumption on these tables is six hundred hours. That means if you get that average light out of the lamp that the curve will hold true. Now, the intention of makers of incandescent lamps—I know it is with the Edison Lamp Company—is to make lamps which for six hundred hours will give their full efficiency in candle-power. After that, there is no guarantee, and nothing said about it. We have now a set of new lamps—a hundred of them—which have run four hundred hours, and only four of the lot have broken. It has always been the intention, and always the claim, that when a lamp is blackened that it should be destroyed. The average light of the lamp is not how long it will stand on, but how long it will keep up good commercial efficiency, and what happens to the lamp after six hundred hours is of no consequence to this. The assumption is six hundred hours at 3.1 watts per candle-power. I think Mr. Howell did not call attention to Fig. 2. I think great consideration should be given to it. It represents, as he says, five years' experience on the part of the Edison Lamp Company, and I remember very well that in 1879 at Menlo Park Mr. Edison spoke a great many times of the great value such a curve would have and also of the exceeding difficulty of getting such a curve: because you have not only to pick out a large number of lamps from the same lot and test them under normal conditions, watching them closely all the time, but to get a good curve it requires many months and even years of constantly keeping lamps burning, and this represents the full experience of the Edison Lamp Company, which, just before Mr. Howell prepared this paper, was carefully gone over, taking in all the lamps which had ever been burned; and I think it can be safely stated to be within a 2 per cent. error. It has cost more than $10,000 to obtain that curve. It is the most expensive curve in the business. (Laughter.) It is a great deal more difficult to obtain than most people would give credit for. It runs into a very difficult experiment. First you have to get your higher values. You cannot have them contemporaneous with the others, because with the higher values of lamps they will break off quickly; the others will continue to burn for many weeks and months; and to get proper values throughout that curve you must know that your regulation and all your conditions are correct. We commenced that relative value curve at Menlo Park and it is only recently that we felt certain that that, as shown there, expresses the law of the Edison bamboo untreated filament.

Mr. WETZLER: I would like to ask the speaker if he has evolved the mathematical expression for that law. What equation corresponds to it? It looks like an hyperbola.

Mr. HOWELL: It is not like a curve that has any name. We have got an expression for it that goes all the way across a sheet of paper. It is an exponential law with a constant increment, and the exponent of it is very difficult to get, and when you get it you cannot differentiate it at all. I will say that it is capable of mathematical demonstration by calculus to show just what that minimum is, and just what that percentage is. But I am free to confess that I cannot do it. You see there are three variables beside the variation between life and efficiency, and that makes four independent variables. The graphical solution is very much the easiest.

Mr. MAILLOUX: I would like to ask Mr. Howell if he has any data, or if he knows of observations which have been made tending to show clearly the difference in life of lamps run at the same watts per candle-power, using different currents. I suppose that we are all familiar with the statement which went the rounds of the press a year or two ago to the effect that an alternating current added life to the filament of the lamp; *i. e.*, that a lamp run at the same watts per candle-power with an alternating current would last longer than a lamp run at the same efficiency with a continuous current. Now I may add that my experience with storage batteries has shown that the life of a lamp is undoubtedly increased at the same efficiency, that a lamp running at three watts per candle-power, for instance, with storage batteries will last much longer than a lamp running at the same efficiency from an ordinary current as furnished by a dynamo. How much the difference is I really cannot say, though, as I have said, there seems to be undoubtedly a difference.

Mr. HOWELL: To determine the life of any lamp there is one absolute necessity, and that is a constant pressure. During the five years in which that curve was determined there was always one man who did nothing else but keep the current constant. You can do that with a dynamo, but you cannot do it with storage batteries. I say you cannot because you cannot in practice; and any man who draws inferences as to the life of lamps from a dynamo and from a storage battery without having done that, may reach wrong conclusions. I have had a good deal of experience with lamps on storage batteries, and I am perfectly willing to be criticised when I make the statement that the pressure on a storage battery plant, as ordinarily installed, varies, I think, five times as much as it does on the average dynamo plant, and that the life of lamps on a storage battery plant, as ordinarily installed, and handled, is very much lower than it is on the average dynamo plant, due to nothing else than the simple impossibility of keeping the pressure anywhere. I mean that that is a defect in the methods more than anything else. They use the lamps and charge the battery at the same time, and have no means of keeping the pressure constant.

Mr. MAILLOUX: I may add that we have found that by using suitable precautions and devices it is possible to secure as constant, if not more constant, electromotive force with a storage battery, as with any other device for producing electricity, so that there should not be any great difference due to that cause. I freely confess that I have had no facilities for making quantitative experiments or determinations by which I could get at the exact value of the difference to which I adverted; but it seems to me that there must be a difference there somewhere, and it would be very interesting to get at what it is.

Mr. HOWELL: It just occurs to me right here that I was asked to investigate the lamps in a storage battery plant. Of course I went into the place as a stranger and asked innocent questions. In this case that I speak of I got the freedom of the plant and talked with the engineer. I said: "Those lamps don't look very bright; do you call that a good light?" He said: "No; that isn't any good, but you ought to be here when the engine is running." (Applause and laughter.)

Mr. MAILLOUX: When you take into consideration that a storage plant that gives nominally about two volts requires from 2.4 to 2.5 volts per cell for charging, and multiply that by 30 you can readily perceive why the light was so much brighter in running the engine.

Mr. HOWELL: There is no question but that the possibilities of the storage battery are very great. For laboratory work, where we want a constant current, there is probably no equal to it for a short time, or probably for any time; but for practical work, as storage batteries are installed commercially, it is very far from giving a constant pressure.

Mr. FRANKLIN L. POPE: So far as I know no accurate experiments have been made to determine the difference in light between a lamp run at an equivalent candle-power with an alternating and with a direct current; but I may say that when I was in England about two years ago, it was remarked of a plant that had been installed in Whiteley's large establishment at the West End and worked directly by an alternating dynamo—I think it was a Ferranti machine—that the lamps showed a longer life with an alternating current than with a direct current, and the reason that was put forward to explain it was that with a direct current the hot carbon was something in the condition of an electrolyte and was more apt to throw off a deposit and disintegrate than when the current was continuously reversed. But I do not know whether there is anything in that or not. I simply state it as the conversation I heard at that time.

Mr. HOWELL: I think an argument drawn from one case or a few cases of that kind is hardly to be depended on very largely, because you take the identical lamps and put them on different plants run from straight or alternating currents, and you get different results due to different handling. It is the most difficult thing that I have ever undertaken, to compare the lives of lamps. Now, as showing the difficulty and the misleading effect of the local conditions in a plant, when we first started in the business we made lamps, of course from 90 to 110 volts, and on our isolated plants we ran lamps from 95 to 100 volts, and those lamps were all made at once. Now the man who put in our plants and who was in charge of the work found a good many plants giving good results with 97 volt lamps. He found that 96, 98 and 99 volt lamps were giving bad results and he drew the conclusion that the 97 volt lamps were better than the 96 and 98. He drew that inference from facts determined from two or three lamps at each time. Now the volts of the lamp had nothing to do with it. The conditions of operating the plant affected the lives in the various cases. If the man who was getting good results from the 97 and the man who was getting bad results from the 96 were to change their places, they would get the same as they did before. The lives of lamps are affected by every condition of running. To draw conclusions from a few lamps is misleading.

Mr. UPTON: I think the question of alternating current and straight current in its effect on the life of lamps is an unsettled question and that there is no authoritative answer to that as yet. All our experiments have so far indicated negative results. The life is the same whether the current be straight or alternating. I do not think there are any experiments as yet proving a material difference between the two, that is, where the conditions are thoroughly watched all through. With alternating currents it is very hard to indicate the pressure.

Mr. F. L. POPE: I quite agree with Mr. Howell that the deduction drawn from a few experiments have no value whatever, and I merely mention it as current talk, without giving very much credence to it myself. I should not be at all surprised to find, after a proper investigation had been made—and it is a matter of no small difficulty, as Mr. Howell says—that there was little or no difference.

Mr. UPTON: As to these curves which have been put on the board to-night, Mr. Howell asked me whether we should publish these results. We discussed it and concluded it was better to publish what we could about the relations between economies and lives of lamps. The time, we concluded, had come when it should be fully recognized that the statement that a lamp gives 2 watts, or 2½ watts, or 3 watts, or whatever it is, per candle, means nothing, until those claims have been verified by long practice, and we know from experience that no lamps can be put upon the market unless they have a large margin over the laboratory test, or otherwise your complaints and troubles will more than counterbalance the gain. These curves that Mr. Howell has presented here are based, I think, safely on commercial practice, and we have chosen in this case about 3 watts per candle as our normal, and we recommend it as embodying our experience and the recommendation of the Edison Company for the best commercial practice.

The Telephone in Mexico.

The Mexican Telephone Company reports slightly diminished earnings for the past year because of unfounded rumors, circulated by hostile parties, that it had no patent rights in the republic, nor power to protect its patrons in the use of the instruments leased to them by the company. This naturally lost some subscribers and prevented obtaining many more. A suit was commenced against this party for infringements of the rights of the company, the Mexican government having granted the company its claim for the Bell and Blake patents. This suit was decided in favor of the company, after a long fight, granting, in the decree, whatever damage had been sustained by reason of the opposition introducing instruments and false reports, all costs of courts, confiscating all instruments in the country introduced by others, all profits made by the opposition on their instruments and business connected with them, and the exclusive right to use and control telephones and telephonic apparatus in the republic of Mexico. As the parties against whom the decision was obtained are reputed wealthy, an old established house in the city of Mexico, a very considerable sum will, it is expected, be realized to the company from this source, and also a large sum from individual users of the proscribed instruments. But for this forced litigation the company would have made a more satisfactory showing for their stockholders from the business of the past year. Already the effect of the suit is apparent from the return of many of the lost subscribers. Appended is a statement of receipts and disbursements for the past year:

RECEIPTS.

Cash on hand March 1, 1887	133.18
City of Mexico office	$37,603.72
Guadalajara office	5,601.05
Puebla office	3,502.05
Oajaca office, six months	1,573.31
Merida office, six months	3,793.54
Total	$52,207.15

DISBURSEMENTS.

City of Mexico office	$37,731.76
Guadalajara office	5,601.11
Puebla office	3,471.98
Merida office	3,726.04
Oajaca office	1,556.15
Cash on hand	120.11
Total	$52,207.15

A New Electric Coal-Cutting Machine.

The application of an electric motor to impart motion to coal-cutting machinery is proposed by Messrs. Bower, Blackburn, and Mori, of Woodlesford, Yorkshire, England. The framework or bed-plate of the machine is supported on wheels. Within the framework is mounted or applied the electric motor, which may be of any suitable construction, and to this motor the electromotive force is imparted through suitable cables from a dynamo machine placed on the surface. A rotary motion is transmitted to the shaft carrying the cutter bar through gearing. The lower part of the framework, to which the upper part of the framework is attached, forms a circular turntable, and is fitted so as to be capable of a rotary movement on the bed-plate, this rotary movement being effected by means of a worm, mounted on a shaft, supported in the bearings, attached to suitable brackets, mounted on the bed-plate, and a worm-wheel segment, attached to the upper part of the framework. By this means the cutter bar can be moved along by the attendant as the coal is being cut, and the proper feed given thereto.

His First Hello.—Johann Schnell, a new messenger in the Navy Department at Washington, is extremely nervous regarding a telephone, never having seen one until a few days ago. He was obliged to answer a call from the instrument recently, and his incoherent answers exasperated the speaker at the other end of the line. "You must have been drinking," Schnell heard the angry individual exclaim. "No, I haven't," said the messenger gently. "It must be the strong tobacco I am chewing that you smell."

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
168-177 Potter Building, New York, April 23, 1888.

The American Electric Manufacturing Company.

Considerable interest has been taken during the past week in electrical circles in the important circular issued by Mr. E. H. Goff announcing the changes that are about to be made in the management of the American Company. The circular says: "A point is now reached where increased and improved factory and manufacturing facilities are required, in order to supply the demand promptly, and at the same time reduce the cost of production to the lowest possible limit. I have previously asked you for the increased capital necessary to accomplish these results, without satisfactory response. During the last six months I have found my health so badly impaired by reason of overwork that I am compelled, under the advice of my physician, and much against my personal wishes, to take a much needed rest, and, therefore, a different method of raising the additional capital necessary to extend and promote the business of the company has been inaugurated, which practically sacrifices my entirely personal and pecuniary interest in the company. In connection with my friends and associates in the business, I have succeeded in inducing Dr. Robert Amory, of Boston, the general manager of our New England Department, to associate with him a syndicate of prominent and wealthy business men in Boston and vicinity, to become largely interested in the company. Dr. Amory will become president and general manager, with a new board of trustees, on condition that the stockholders will unite with him in pooling their stock with him and his friends in the American Loan and Trust Company, in order that he may be sure of the active and mutual support of the stockholders, as a protection for him and his associates in furnishing whatever additional capital is required for the purposes above mentioned."

The stockholders are, therefore, asked to co-operate in this movement, and Mr. Goff will remain in charge until the plans are carried out.

Subway Plans.

I hear a great many inquiries on all hands as to subway work, but it does not appear that there will be much done until the Mayor and the other Commissioners compose their differences. In the meantime some satisfaction may be derived from the fact that it has been held proper for the Comptroller to pay the expenses of the Board of Electrical Control in advance of collecting the assessments from the various companies having wires in the city.

The Magnetic Club.

As the result of the social gathering of the officers and leading members of the various telegraphic organizations in this city—the Telegraphers' Mutual Benefit Association, Building Society, etc.,—the above-named club has now been formed "for the purpose of promoting social intercourse among its members," who may be any persons who are engaged in electrical pursuits and are eligible in the usual way. At a very well attended meeting held in the Western Union Building on April 19, a constitution was adopted, and the number of members for the present was fixed at 100. The entrance fee is 50 cents, and the dues are only 50 cents a year, all the expenses of the social gatherings, of which four every year are proposed, being met by those who actually participate. Another meeting is to be held this week, when officers will be elected and other business will be dispatched. The club has already enrolled a number of the best men in the telegraphic field of work, and promises to be useful in a variety of ways.

A Lineman's Torch.

The Wellington Manufacturing Company, of 464 Cherry street, this city, are making a furnace or torch for fusing metals or soldering wire joints. It can be used in any position without interfering with the flame. It has a small pump below the handle, which allows cold air to enter the vessel at the bottom, thereby forcing the flame forward even if the torch be held upside down. The advantages of this for aerial or conduit wire work are too evident to need comment.

The Eickemeyer Dynamo.

Great interest has attended the evolution, if I may so call it, of the Eickemeyer dynamo, of the iron-clad type. This machine in its perfected form is now being built by Osterheld & Eickemeyer, of Yonkers, N. Y., and it can be seen at the establishment of J. H. Bunnell & Co., 106 Liberty street, this city, the firm being the selling agents for it.

W. T. H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
48 Congress Street, Boston, April 23, 1888.

An Interesting Course of Lectures.

Mr. Edward Blake, of the firm of Sawyer & Blake, Boston, recently began a course of lectures before the Senior Electricals at the Massachusetts Institute of Technology. The subject of Mr. Blake's lectures is, "The Electrical Transmission of Energy."

Death of President Dickinson.

Mr. Charles Dickinson, president of the Benedict & Burnham Manufacturing Company, Waterbury, Conn., and of the Waterbury Watch Company, died suddenly last week at Old Point Comfort, Fort Monroe, Va., where he had gone for a fortnight's rest and recreation. He was 62 years old, and was born in Saybrook, Conn.

Erie Telephone.

The strength of Erie Telephone has been a prominent feature in the market of late. The substantial prosperity of the company shows no decrease, but is steadily maintained, and the Erie is in fine condition in every way. Its surplus amounts to nearly $90,000. The regular dividend for the quarter ended March 31 will be declared the latter part of this month or the first of May, and will be 75 cents per share. There is talk of an extra dividend of one-half of one per cent., or 50 cents per share, the company being amply able to pay it from cash on hand should the directors deem it advisable, which is quite probable. The adjournment of the Ohio Legislature without passing any rate bill, and the failure of the City Council of Cleveland to adopt any underground ordinance, are very gratifying to the Erie company.

"Loomis" Incandescent System.

The incandescent system of the Loomis Electric Manufacturing Company, of Boston, is being installed in the establishment of Mr. Henry Wanklin at Philadelphia.

Electric Lights for Gloucester, Mass.

The Gloucester Electric Company has been organized with a capital of $20,000. Mr. Wm. H. Jordan is president, and Mr. Joseph O. Potter treasurer. The above named and Messrs. William Thompson and Francis Proctor are directors.

The Electric Light Plant at Malden, Mass.

Early in January last a syndicate, of whom Mr. H. A. Royce, of Boston, is treasurer, purchased the electric light plant in Malden, and at once began enlarging and devoloping the same. The capacity of the plant at that time was about 100 lights. A brick station is now being erected with a capacity of 500 lights, and will be fully equipped with the Thomson-Houston apparatus. They expect to have the entire work completed by May 15. The contracts have been made with the Jarvis Engineering Company for Armington & Sims engines, Whittier boilers and Jarvis settings, equivalent to 500 horse-power, the piping to be done by Wm. S. Gallison, of Boston. The Malden city contract for arc lights has been increased from 25 to 70, besides 300 alternate incandescent street lights of 25 candle-power each. The territory of the Malden Electric Company embraces Everett, Melrose and Medford, and on account of the rapid growth of these towns it is expected that the number of lights required will rapidly increase beyond the above figures. All of the construction is now rapidly going on under the immediate direction of the superintendent, Mr. Alfred E. Bliss.

Electric Lighting at Winthrop, Mass.

The North Shore Electric Light Company has secured the right to put up poles in Winthrop for lighting private buildings and hotels, and has made an offer to the selectmen for lighting the streets of Winthrop. The lamps now in use cost the town $1,000 a year, and it is thought that when the selectmen meet a week from now the company's offer will be accepted, the only objection offered being the slight increase necessary in the appropriation for lighting the streets.

Providence, R. I., April 16, 1888.

At present the Rhode Island Electric Light Company are busy rebuilding their main line through the central part of the city. The material will consist of 10 inch by 10 inch by 38 feet hard pine poles, set in the ground seven feet, making 31 feet above the surface. The cross-arms are of best hard pine, 3 inches by 4 inches by 6 feet, having eight pins each and averaging four arms to a pole.

The two top arms are used by the Narragansett Company, and the two lower ones by the Rhode Island Company. There are fourteen lamps to be suspended by the Russell Manufacturing Company's mast arm in the centre of the street. This mast arm is composed of a piece of 2½-inch gas or steam pipe, having a slot cut in the under side from end to end ¼ inch in width, through which extends or drops a pendant or flat piece, which is supported on a small carriage having four beveled wheels cut to fit the inside periphery of the pipe.

To this protruding piece is fastened the lamp, which is drawn in and out from the pole by means of a cord passing through the pipe and over a pulley placed at the outer end of the pipe by means of rollers placed on the mast in reach of the operator. The main pipe is braced from the sides midway and is fastened to the mast by a flange. By means of the arm a lamp can be placed anywhere from five to thirty feet out from the mast according to the height of the mast. This has been in use in Providence city since March 1 and passed through the blizzards of March 7 and thereabout. As the pendant from which the lamp hangs has a knife edge on both sides it readily cuts any ice or snow that might freeze on the apparatus. So far they have had no trouble with it in the least. The station is running about 800 16 c. p. incandescent lights, 230 2,000 c. p. arc lights, and 160 Moguls installed lights, and business is still rolling in. Things are running smoothly, and both companies are working hand in hand to give the people of Providence a fair service for a fair price. The companies are using the Baxter motor on arc circuits with great success. It seems to govern or adjust itself to the circuit or current in a most satisfactory manner and does all that one could ask of it. Mr. John I. Drake, the superintendent, says that they are much pleased with it. Providence will soon be able to boast of the finest construction of any city, as both the electric lighting companies are spending freely in the construction of fine new lines.

Pittsfield, Mass.

The Westinghouse Incandescent Electric Light Company here are putting up 75 and 100 c. p. lamps on the street, with a view to their adoption by the city for street lighting.

The arc light people report a good business and are constantly adding to their number of lights, which are of the Thomson-Houston system. There is a project on foot to start an Edison plant in the beautiful town of Lenox this summer. The wealthy summer visitors would undoubtedly be large consumers. There is an Edison plant being put in at Great Barrington in the southern part of the county, and Adams and Lee are both to have plants this year—Lee an Edison and Adams an arc, probably Thomson-Houston.

The Berkshire Electric Company report recent large sales to New York and Boston parties of their well-known "Acme" manganese batteries for open-circuit work.

PHILADELPHIA NOTES.

Branch Office of The Electrical World,
39 South Tenth Street, Philadelphia, Pa., April 21, 1888.

The Edison Plant at the Grand Opera House.

The New Grand Opera House at Broad street and Columbia avenue, this city, has one of the most elaborate and artistic plants in the United States. The plant was designed and installed by Messrs. Walker & Kepler, the general agents in this city of the Edison Company, and all of the work was done under the immediate supervision of these gentlemen. There are two 450 light dynamos, and two 90 h. p. Ball engines in the engine room, which is separated from the main building by a four foot wall, and the boiler room is in an entirely separate structure, 350 feet distant from the theatre proper, the steam being carried underground. There are in the theatre and the stores, offices and stables, which are in the one large building, 1,140 lamps. In the centre of the theatre ceiling there is a group of 120 lights, each of which is backed by a silver-plated reflector, giving the entire bunch the appearance of a mass of stars, and the effect produced is grand. Around the borders of the first floor are five groups of 55 lights each, and the footlights are made up of 50 lamps. On the stage there are ten bunch lights, each having ten lamps, and in the dressing room there are 77 lights. Around the upper lobby there are placed 22 two-light brackets, and in the lower tier 15 two-light brackets. In the upper gallery there are 17 five-light electroliers, and in the lower gallery 15 three-light fixtures, while in front of each of the boxes there are six-light electroliers. The plant is so arranged that both of the engines and both of the dynamos would have to break down in order to disable the plant, and every possible contingency has been provided for, the only gas provided being sufficient to dismiss an audience in the case of a complete breakdown, which seems impossible.

The resistance boxes controlling the eight circuits used for the theatre are placed in such a position on the stage that all of the circuits can be thrown off at a moment's notice by any of the employés. The stores in the front of the building are also lighted by the main plant, and 150 lights are used, while the Germania Brewing Company, in their offices and stables, use 75 lights.

The exhaust steam from the engines is used to heat the entire building, and the plant is so well and economically arranged that no more steam is used in lighting it than would be used ordinarily for heating. In the summer time the engines will supply cold air to the theatre, and also to the refrigerating house of the Germania Brewing Company. The National Opera Company, which opened the theatre last week, used a number of the lights for the flower scenes in their productions, and during their engagement no gas has been used. The members of this company pronounce the plant the finest in the country, the ceiling group being the most unique and beautiful ever seen by them. The fixtures for the plant, including the electroliers, were furnished by Messrs. Cornelius & Rowland, of 1612 Chestnut street, this city, and are of beautiful design and artistic workmanship. Messrs. Walker & Kepler feel justly proud of their achievement in making this theatre in every way the most beatifully and thoroughly lighted of any in this part of the country. They consider it unequaled.

Whitney Glass Works.

The Whitney Glass Works, whose factory is at Glassboro, N. J., with their principal office at 227 South Front street, in this city, is not only the oldest but the largest establishment of the kind in America. The plant was first put in operation in 1775, just 113 years ago, and the reputation earned has made the house one of the most solid and conservative of business establishments. Six hundred employés are now on the pay roll of the firm, and the business they are now doing in the electrical field has necessitated an increase not alone in the number of hands, but in the size of the plant. They have just completed arrangements for the turning out of all classes of glassware used by electrical firms and experimenting electricians, and are already in receipt of a large number of orders for this kind of work. The fact that they have not been in any way affected by the recent flint-glass workers' strike has been the means of crowding them considerably with orders which could not be filled elsewhere, but they have kept well up with the demand. The quality of glass turned out by this firm needs no mention, since it has stood the test of so many years by the leading consumers of the country.

Electric Against Gas Lamps.

Select Councilman Kenton introduced a resolution in Select Council a few days ago for a report upon the efficiency of the Siemens regenerative lamps in the public squares. Mr. Kenton complained that the lamps did not give satisfaction and that they were more costly than electric lights. It is claimed that the lamps consume from forty-five to fifty feet of gas per hour, about ten times as much as that used by the ordinary street lamp. As it is estimated that it costs the city $25 per annum to supply gas to the ordinary lamp, it will cost about $250 to furnish a Siemens lamp with gas for the same period. The average cost of electric lights is 54 cents per night, or $197 per annum, making a difference of $53 a year in favor of the electric light. There are 170 Siemens lamps located in the various squares, as follows: Rittenhouse, 26; Franklin, 22; Washington, 26; Independence, 22; Jefferson, 18; Wharton, 12; Norris, 18, and Logan, 26.

Other Edison Plants.

Messrs. Walker & Kepler have now in course of installation a 600-light Edison plant in the new building of the Beneficial Savings Fund, using a 250-light Edison dynamo, and an Armington & Sims engine. The plant will be so arranged that it can be at any time thrown on to the central station circuit, the idea being to furnish light at night when the engine in the bank building would not be run. The street current, when used, will be measured by meter. The new St. John's School at Eddington, built by the Misses Drexel, is being supplied with a 650-light plant, two Edison dynamos and two Armington & Sims engines being used. Messrs. Walker & Kepler have taken the contract to furnish everything, even to the fixtures.

A Lamp of Long Life.

A 16 c. p. Edison lamp, which was placed in circuit Jan. 17, 1884, was taken out of a large manufacturing establishment on Feb. 29 last, after having been burned about 18,000 hours. This lamp is now in the office of Walker & Kepler, and still gives a good light. It is believed to be the longest lived incandescent of which there is a record.

Specialties for Steam Users.

All steam users, and particularly those engaged in the electric light field, will find it to their advantage to secure from Messrs. Watson & McDaniel, of No. 144 North Seventh street, Philadelphia, one of their new catalogues of patented specialties for users of steam. The list of valuable acquisitions to any steam plant includes Chapman's steam trap, Watson's pressure regulator, and McDaniel's exhaust pipe head, suction fitting, suction tee, and

relief valves for water. The firm has been doing a large business with electric light companies, and the superiority of the class of goods they handle certainly entitles them to it.

Rapid Electric Transit.

A meeting of the Committee on Railroads of City Councils was held Thursday, at which a communication was read from the Rapid Transit Electric Company, requesting the privilege of using the abandoned tracks on Twenty-ninth street. The matter was postponed for the purpose of hearing from the parties interested. The company's purpose is to demonstrate the advantages of their system of electrical street railways.

Batteries for Railroads and Other Use.

The Pennsylvania Railroad and the Delaware & Atlantic Telegraph and Telephone companies have adopted the Partz acid gravity porous cup battery, and have given the Partz Battery Company large orders. The city also intend using this battery for the fire patrol service. The Partz Company are constructing a special battery of 20 cells, which can be hermetically sealed at will, to be used on a small pleasure yacht where a motor will be used.

Combination Fixtures.

The firm of Cornelius & Rowland, 1612 Chestnut street, have finished an order for some magnificent combination gas and electric light fixtures for the residence of Lewis S. Cox, a wealthy merchant at Jenkintown. This firm are doing a large share of the electrolier business in this city, and are kept busy on new orders.

Plant for a Clothing House.

The Philadelphia Cloak and Suit Company, 626 Market street, are arranging to run their own electric light plant, and have already purchased, through Mr. J. W. Parker, a 12 × 12 90 h. p. Ball engine. Mr. T. P. Conard, whom Mr. Parker represents, has contracted to install the plant.

Personals.

Mr. George W. Lord, of boiler compound fame, has been compelled to strengthen and increase the size of his building at No. 316 Union street, in order to accommodate a largely increased business.

E. W. E.

PENNSYLVANIA NOTES.

PITTSBURGH, April 13, 1888.

Lighting Competition.

The Councils of Allegheny have just asked for proposals for lighting the entire city by electricity, with both arc and incandescents. The competition will be quite sharp. The Ball Company are already on the ground. The interest is so great that the Councils have given them permission to erect a plant on one of the public squares to make an exhibit of their system, and the Council propose to grant the same privilege to any other competitor that will make an exhibit. Already two or three additional companies are arranging to accept the offer of free land, free water and fuel (natural gas).

The Allegheny County Light Company will compete, but having a station already established have no occasion to accept the offer of the City Council for a new station. If the owners of any of the numerous systems extant are desirous of having them introduced to the public here they cannot have a better opportunity. Letters on the subject and applications should be addressed to R. T. White, city clerk, Allegheny, Pa.

The Westinghouse Company.

The Westinghouse Electric Company have declared a stock dividend of 3½ shares, new stock, for one of old stock, and will pay a cash dividend on May 1. They are crowded with orders, and are increasing their business daily.

The Allegheny County Company.

The Allegheny County Light Company have now 15,000 16 c.p. incandescent lamps in operation and are increasing the number constantly.

Electric Railroads.

The Observatory Hill Electric road in Allegheny is now running regularly after a number of delays and troubles of various kinds. The road will be extended to Pittsburgh in a short time, the necessary right of way having been obtained from Councils. The Knoxville Electric road is in operation, but not regularly. They have had a great many difficulties to overcome, but will sooner or later "get there" in good shape.

The East End.

The East End Electric Light Company have started their new station, and it is very complete in every respect. They are operating the Westinghouse alternating current system, and have some 5,000 lamps installed. Their longest circuit extends over six miles from the station, and the operation of the lamps at that great distance is perfectly satisfactory in every respect. They are doing a large amount of residence lighting, all of which is reported as entirely satisfactory. It is the intention of the Westinghouse Electric Company to introduce their new electric meter within a few weeks. It is said to meet the wants of the case.

P.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, April 21, 1888.

Doings in the City Council.

An order granting the Telephone Company the right to remove wires from old subscribers who move May 1, introduced in the Council on Monday night, was referred to the Committee on Fire and Water. The whole subject of the electric lighting ordinance at this meeting of the City Council was shelved for the time being by referring the same to the Committee on Gas and Electric Lighting.

Electrical Supply Company.

The Electrical Supply Company has just issued a handsome illustrated catalogue of the house goods manufactured and for sale by them. A room formerly used by the Electrical Construction Company is now used by them for a storage room, besides which they have also greatly increased their shipping facilities. To their already numerous agencies they have added that of the sole agency of the blue vitriol manufactured by the Chicago Copper Purifying Company, which they are enabled to furnish at factory prices.

Andrews & Johnson.

Andrews & Johnson, of this city, manufacturers of exhaust fans, find an increasing demand for their goods to be run by electric motors in offices, restaurants, dynamo rooms, engine rooms, etc. The motor seems to be just the thing for running this sort of machinery, which is getting to be important in its uses, especially during the hot weather. They report recent correspondence from electrical people in different parts of the country.

Thomson-Houston Company.

The Thomson-Houston Company report the following recent orders: Kalkaska, Mich., 30 arc lights; Akron, O., 35 arc lights, to increase the plant of the Citizens' Electric Light Company; Houghton, Mich., 30 arc lights, to increase the plant of the Peninsula Arc Light and Power Company; Jackson, O., a new plant of 35 arc lights; Pella, Ia., new central station of 300 incandescent lights.

The Thomson-Houston Company, after severe competition from other electric light companies, have just been awarded the contract by the Dakota Building Association for lighting the Wanamaker & Brown building, corner of Adams and State streets, with 35 arc lights. The contract for lighting the Panopticum building with 500 incandescent lights has also been awarded them.

Anti-Magnetic Shield Company.

The Giles Anti-Magnetic Shield Company on Friday night of last week had a little fire at its factory, which necessitates its moving into new quarters, and work will be hindered for a few days. The loss, which was not large, is fully covered by insurance.

Central Electric Company.

The Central Electric Company, McKinlock Bros., report a large and increasing demand for the "Candee" weatherproof wire, for which they are the western agents. They say electric light people look on this wire as one of the best substitutes for underwriter's wire on the market.

City Lighting.

The electric light appropriation will be utilized immediately by commencing a central plant, around which to group other systems. The Mayor has directed Professor Barrett to prepare plans for a plant to light Clark street from the river to Van Buren street, and Madison street as far west as Halsted street. The system will be extended if the funds permit.

Cincinnati.

At the exhibition I mentioned last week, to be held at Cincinnati this summer, commencing July 4, celebrating the Ohio Valley Centennial, the electrical exhibit will be one of the most important features. All manufacturers of and dealers in electrical goods are preparing to do their very best.

Electrical Construction Company.

The Electrical Construction Company have just moved into their new quarters, 175 Randolph street, and will soon be in good shape for attending to their greatly increased business. The company have also been reorganized, having bought out the interest formerly owned in the company by the Electrical Supply Company. The officers of the new organization are: Vincent Harter, president; Walter Whipple, vice-president; G. A. Harter, manager and secretary. The capital stock is also increased. As I stated last week, their facilities for manufacturing will be increased.

The Belding Motor and Manufacturing Company.

The Belding Motor and Manufacturing Company are moving into the Burton Manufacturing Company's building, corner of Van Buren and Clinton streets, having found it necessary to do so on account of their business. They will have about six times more space than they formerly occupied, and are increasing their manufacturing facilities by the addition of two new dynamos, lathes, drills, punches and special machinery.

Col. S. G. Lynch, broker, 146 La Salle street, furnishes quotations upon telephone stock as follows:

Bell of Mo.	$160	@ $165	Iowa Union	$26	@ $27
Central Union	47	@ 48	Michigan	78	@ 80
Chicago	375	@ 400	Missouri and Kansas	70	@ 72
Colorado	19	@ 21	Rocky Mountain Bell	40	@ 45
Cumberland	65	@ 68	Wisconsin	108	@ 109
Great Southern	35	@ 40			

E. L. P.

ENGLISH NOTES.

LONDON, April 11, 1888.

Electric Lighting in Theatres.

It had been hoped that this year would see some legislation enforcing the use of the electric light in theatres, at all events behind the scenes, but the Local Government bill, which is the great measure of the session, will hand over all such powers of regulation to the local authorities, and nothing therefore will be done for the better protection of theatres against the risk of fire from gas until that bill comes into operation next year or the year after. Meantime, however, it is gratifying to notice that the electric light is winning its own way in the favor of theatrical managers, and that its adoption is made one of the attractive features in the advertisements of many of the existing theatres and of all the new ones about to be erected.

Local Lighting.

Local authorities are not, however, waiting their new powers before giving the electric light a trial as a competitor of gas for street lighting. From quite a number of provincial towns, not by any means exclusively in districts where coal is scarce and gas expensive, we hear of the town councils calling in the aid of electrical engineers on the lighting question. Several are instituting experimental trials over a limited town area, and others are advertising for tenders to do the business on a larger scale. To some of these "a new discovery" made by the local authorities at Southampton has operated in a very encouraging way. Southampton destroys its town refuse by cremation, and casting about for some useful purpose to which the waste energy of the furnace can be turned, has bethought itself of the electric light. The costly item of fuel would thus be saved if the experiment proves successful, as it really promises to be, and we may expect from it not only an extension of electric lighting elsewhere, but the further boon of effectually destroying a considerable portion of those sources of disease which have hitherto been so difficult to get rid of in populous towns.

Government Purchase of the Telephone.

The Associated Chambers of Commerce have been promised an interview, which is to take place in a few days, with the Postmaster-General, on the subject of telegraphic and telephonic charges. The objects of the deputation are, first, to urge the adoption of popular rates over the Anglo-Continental cables as soon as they become the property of the governments concerned. The British Postmaster-General will have a preponderating voice in determining these rates, and as he is known to be favorable to their material reduction there is not much need to interview him on the subject, especially as the transfer does not take place till the beginning of next year. The second and paramount object of the deputation is probably to extract from Mr. Raikes some more explicit statement of his intentions with regard to the relations of the telephone companies with the public on the one hand and the post-office on the other. Ever since he made his public expression of dissatisfaction with these relations, and notwithstanding his parliamentary disclaimer of any intention to purchase and absorb the telephone systems into the postal telegraph system, the opinion that he ought to do so has been gaining ground, and this opinion is strengthened by the effect his declaration has had on the policy of the companies concerned. This policy is, briefly, to so conduct their business as to compel the Postmaster-General in the interests of an aggrieved public to show his hand: in other words, to precipitate the State purchase which most people believe to be sooner or later inevitable. As the Chambers of Commerce are much interested in this question, great things are expected of their forthcoming interview with the Postmaster-General.

Telephone Rates.

Meanwhile the provincial companies are being urged to push forward their extensions as rapidly as possible, and the parent company, which has exclusive possession of the metropolis, is loudly blamed for its dilatoriness in this respect. Its charges are certainly higher, and its service is said to be worse than that of any company outside London. Further the accommodation is far less complete. Many causes, quite apart from any want of enterprise on the part of the United Telephone Company, contribute to hinder its popular development in this vast city; but it is a very remarkable fact that the revenue per head of population derived in the metropolis is less than half what the average provincial companies derive from their areas of operation. In some cases it is much less than half. For example, in the area of Liverpool and Manchester the population served is said to be 1,600,000, and the gross revenue earned by the company serving it amounts to £75,914 per annum; whereas from the metropolitan area, which covers a population of nearly 5,000,000, the United Telephone Company take only £89,955. The fact that this great difference in the earnings of the Metropolitan Company and its subsidiary companies in the provinces is largely due to the trunk line and long-distance telephone business conducted by the latter, makes the grievance in respect to the former all the worse; for London is virtually denied this great privilege which every other town of importance in the country enjoys—the privilege, namely, of being able to speak telephonically to neighboring towns. The probable explanation is that the United Telephone Company, which derives a royalty from all the subsidiary companies, prefers to let them undertake the more hazardous part of the business; and thus the metropolis has to wait for its long-distance telephony until the long distances come to it—that is to say, until the provincial companies extend their operations so as to bring London within the network of their systems. This may be very good policy, but it is very exasperating to Londoners, and probably would not be endured but for the company's overheard wires, whose unpopularity tends to exempt it from any general demand for an extension of its ramifications.

Postal Telegraph Revenues.

Nothwitstanding the growth of the trunk line telephone business above referred to, and the competition with the telegraphs which such growth implies, the revenue of the Postal Telegraph Service does not betray any falling off on that account. The increase of £120,000 in the gross receipts for the financial year just ended, over those for 1886-87 is spread through the year in pretty equal amount, showing that although the increase is not progressive in any marked degree it is steady and constant. It will take some years to recover the ground lost by the introduction of the six-penny tariff three years and a half ago; but the administration is confident of the ultimate success of the experiment, and does not admit that the telephone is doing the telegraph service any harm. Opinions differ on this point, but there can be no doubt that the general prosperity of the country evinced great improvement last year, an improvement which is always reflected in the telegraph receipts, and no doubt also in those of the telephone. As regards the latter, a comparatively new business, comparisons of the number of messages cannot easily be made; but in respect to the telegraphs the increase is known to be enormous. At one large shipping port in the west of England, not by any means of first-class importance, the number of telegrams dealt with in 1887-88 was exactly double the number for the year previous; and when I add that the increase was from 800,000 to 1,600,000, the significance of the figures cannot be gainsaid.

Government Aid to Science.

A somewhat unpleasant discussion took place in Parliament on the civil service estimates last Friday, relating to the expenditure on the science and art department at South Kensington, the outcome of which will probably be some rather startling disclosures. Enormous sums of money have been spent by the nation with the idea of promoting science and art and the spread of technical instruction through the instrumentality of South Kensington. But, although the buildings cover a large area of ground and are architecturally worthy of the nation, somehow or other they are not occupied as they were intended to be and the funds do not get distributed on the right objects. At the present moment one of the most important science schools connected with the establishment has to find fresh quarters because there is no room for it, and no money forthcoming to furnish them elsewhere, although the yearly expenditure on South Kensington as a whole amounts to a very handsome sum. Nobody exactly knows where the money goes to, some saying that it is lavished on professional

salaries, others that it goes to official sinecures. There is to be an inquiry; meanwhile only one thing is certain, that government aid for purposes of this kind is always liable to be abused, in this country as in others. With the very best disposition toward science and art, the British Nation is not able to get money's worth for its liberal endowments. No wonder that a large section of politicians do not believe in government grants for such purposes, and would leave them to private enterprise or local effort.

A Big Switchboard.

I have recently seen one of the largest switchboards, probably the very largest, which has yet been made in this country. It is mounted upon two slabs of slate, each measuring about 6 ft. by 10 ft., and has been built by the United Electrical Engineering Company for the Aluminium Syndicate. This syndicate is working the process of Dr. Kleiner, which differs entirely from that of Messrs. Cowles. Dr. Kleiner's method consists in taking a mixture of powdered carbon and cryolite, which is placed in a crucible and a small current from a dynamo of high E. M. F. is sent through it. The cryolite gradually fuses, and as it does so the resistance falls, until at length a current of upwards of 1,000 ampères can be passed through the crucible. This effects the reduction of the aluminium. The switchboard in question is intended to control a plant consisting of one high-tension dynamo, three low-tension dynamos and 18 crucibles. The switches are all made in accordance with a design due to Messrs. Drake & Gorham, which is known as the "adjustable ring contact." Contact is made by a straight bar of metal, which is forced between the jaws of a substantial C-shaped piece of brass. In this pattern it is not necessary to provide any spring throw-off, as it is impossible to open the switch without giving it a strong wrench, so that immediately the contact piece is free from the ring it flies open. A screw is threaded through the ring, so that by tightening the screw the jaws can be adjusted to any required distance apart.

Methods of Distribution.

To-morrow (Thursday evening) Mr. R. P. Crompton will read a paper before the Society of Telegraph Engineers and Electricians on "Central Station Lighting, Transformers and Accumulators." Mr. Crompton's views upon this subject are already pretty well known, and it is safe to assume that he is fully determined on this occasion to demonstrate the entire futility of transformers and the perfection of the battery system.

Alternating Currents for Motive Power.

The papers read before the Chicago Electric Club by Mr. Leonard and Mr. Slattery have been reprinted in the electrical journals in this country, and have aroused very considerable interest. The general opinion appears to be that the case against transformers has broken down, and in the light of accomplished facts it is difficult to see what other view can reasonably be entertained. Undoubtedly the most serious deficiency of the system is in non-applicability to the distribution of motive power, but I happen to know that very considerable success has quite recently been obtained in this country in the application of what may be fairly called an entirely new idea to the construction of alternating current motors.

THE TELEGRAPH.

The Central Auxiliary Fire Alarm Company, of New York, has been incorporated by W. H. Whiton and others with a capital stock of $500,000.

A Sad Death.—A special dispatch from Scarsborough, Ia., of April 15, says: Early this morning our citizens were startled at the terrible death of Miss Bridget McNamara, of New-Sharon, who had been acting as night telegraph operator for a short time. About 4 o'clock she attempted to deliver a message to the engineer of a wild train north bound. In some unaccountable manner she lost her balance and fell across the track in front of the engine, and her lifeless and headless body was found between the platform and the track.

Pacific Cables.—A dispatch of April 21 from Montreal, Can., says: A cable dispatch from London says: "The impression prevails that the British annexation of Fanning, Christmas and Penhryn Islands in the Pacific indicates that a British survey, which has always been regarded as essential to establish the practicability of a Pacific cable, is about to be undertaken. It is alleged that apart from the commercial value of the cable, the imperial Government realizes that it would serve to bring the several British naval stations within touch of each other."

Western Union Taxes.—At Harrisburg, Pa., on April 18, an opinion was handed down by Judge McPherson in the case of the State against the Western Union Telegraph Company, an action to recover the tax on capital stock said to be due the State for the years 1877 and 1882 inclusive. The company had settled for this tax based upon that proportion of its capital stock represented by the pole mileage in Pennsylvania, but the State made new settlements on the basis of combined pole and wire mileage instead of the pole mileage alone. This would have included all leased lines which used the poles of the Western Union Company The claim of the State was for $72,594.84, which the court cuts down to $13,809.70, upon the ground that the corporations using the poles of the Western Union Company had already paid a tax upon their capital stock.

THE TELEPHONE.

Pan Electric.—Judge Morris, at Baltimore, has signed a final decree perpetually enjoining the Pan Electric and Washington telephone companies.

Cortland, N. Y.—The Empire State Telephone and Telegraph Company have lately put in a new and enlarged switchboard in their exchange, embodying certain improvements made by Messrs. Gould and Smith. The board was built by the Eastern Electrical Manufacturing Company, of Tonawanda, N. Y.

Telephony in India.—The following is on the rounds: "It appears that the principle of the telephone has been known in India and Burmah for 2,000 years. Mr. Fred Amesbury, of New York, who has just returned from a two years' sojourn in that country, says that the communication is confined entirely to the temples, the natives believing it to be the 'governing spirit.' The wire was some kind of metal, but neither steel, copper nor brass, although it closely resembled the latter. The transmitter was of wood and about the size of the head of a flour barrel, and to establish connection, instead of ringing a bell, the person wishing to attract attention at the other end stood close to the curious looking thing and shouted: "Ooey! ooey! ooey!" The sound is faint but distinct. The telephone which Mr. Amesbury describes has been in use thirty years, and he was shown worm-eaten transmitters and conduits that must have been 200 years old."

THE ELECTRIC LIGHT.

Morganton, N. C.—Mr. J. C. Mills will put in an electric light plant.

Washington, D. C.—Mr. Austin Herr wants electric lighting apparatus.

Little Rock, Ark.—Mr. H. Robbins is buying plant for fifty 16 c. p. lights.

Richmond, Ky.—E. Forman & Son are putting a plant in their flour mill.

Greensboro, N. C.—Mr. R. L. Vernon is reported to want an electric light outfit.

Terrell, Tex.—Mr. Stephens is now forming a company to put in an electric light plant.

Penacook, N. H.—Mr. H. F. Brown is interested in the new plant to be put in at Penacook.

Lexington, Va.—Mr. W. H. Ruffin, of Danville, will probably put in a plant at Lexington.

Columbia, S. C.—The Congaree Manufacturing Company proposes to put in an electric light plant.

Booneville, Mo., is agitated on the subject of electric lighting. The matter comes up for town vote on May 8.

Wesson, Miss.—The Mississippi Mills, at Wesson, is building a big new mill, and is to put in an electric light plant.

Ensley City, Ala., is to have an electric light plant put in, it is said, by the Tennessee Coal, Iron and Railroad Company.

Middletown, Del.—The Electric Light and Power Company is to put in two more dynamos with additional engine and boiler capacity.

Denton, Tex.—The Water and Electric Light Company, of Denton, has been organized to put in water-works and an electric light plant.

Topeka, Kan.—The Edison Company at Topeka is now running some 5,000 lights, and is making arrangements to increase its capacity.

Richfield Springs, N. Y.—The Westinghouse system has been adopted by the authorities for street lighting; incandescent lamps to be used.

Orchard Hill, Ga.—Mr. J. D. Cunningham, of Orchard Hill, is desirous of purchasing an outfit of about 35 h. p. dynamo, engine and boiler.

Phœnixville, Pa.—The Phœnixville Electric Light and Power Company has been formed by A. Bonzano, F. A. La Roche and others.

Berwick, Pa., wishes to put in street electric lights. The chairman of the committee is C. H. Zenuder, to whom inquiries may be addressed.

Omaha, Neb.—An incandescent plant is to be put in by the local school board in the night school building for both practical and educational purposes.

West Fairlee, Vt.—Arc and incandescent plants are wanted by the Copperfield Mining and Smelting Company for their concentration mill and ore dumps.

Lansingburgh, N. Y.—The taxpayers of Lansingburgh have voted against electric lights for the streets. They will change their minds by and by.

Gravesend, N. Y.—The Atlantic Electric Light Company, of Gravesend, has been incorporated by J. J. Powers and others with a capital stock of $25,000.

Los Angeles, Cal.—The Lowe Gas and Electric Company has been incorporated at Los Angeles by T. S. C. Lowe and others with a capital stock of $2,000,000.

Christiansburg, Va.—Mr. C. P. Pool, the electrical engineer, of Lynchburg, is to put in a plant of 100 lights of 30 c. p., using water power with a 25 h. p. overshot wheel.

Denison, O.—The Home Electric Light, Heat and Power Company of Denison, O., has been incorporated by M. Moody and others, with a capital stock of $15,000.

Decatur, Ala.—The central plant to be put in by Mr. W. H. Fleming will have a capacity of 2,000 incandescent lamps, using Thomson-Houston direct and Westinghouse alternating machines and Sawyer-Man lamps.

Columbia, S. C.—The Congaree Gas and Electric Company has been formed and will put in an electric light plant. J. T. Sloan, Jr., is president, W. H. Gibbs vice-president, and J. B. Thomas, Jr., secretary and treasurer.

St. Joseph, Mo.—Tenders for furnishing 200 lamps of 16 c. p. with dynamo, high-speed engine, boiler, heater, feed-pump, etc., should be addressed not later than May 14 to the county clerk of Buchanan County, St. Joseph, Mo.

Virginia.—The American Telephone Company Consolidated, of Alexandria, Va., has been chartered to manufacture telephones, telephone supplies, etc., erect electric light and power plants, etc. The capital stock is reported to be not less than $7,000,000.

Waltham, Mass.—The American Watch Company, of Waltham, Mass., has been looking into the subject of electric lighting, and has now placed an order for a Mather incandescent plant of 2,000 lamps with Claflin & Kimball, the New England agents of the Mather Company.

Silvey Dynamos.—The Lima, O., *Gazette* says: The Silvey Electric Company have a 35-light machine completed for Ada and are waiting on the putting in of their engine to test the machine before sending it out. They are getting out a plant to go to the Cincinnati exposition and are building a 100,000 candle-power light to go with it. But one light of this size has ever been constructed. That was by the Brush Company for the British navy. One light of this size is equal to 50 lights the size that are used in lighting the city.

Grafton, W. Va.—It has been the intention of the Grafton Gas Company to add an electric light plant, but at the meeting of the board, on April 5, it was decided to postpone making the addition for a little while. Mr. C. O. Newton is the superintendent of the company.

Augusta, Ga.—The Augusta Factory, which makes shirtings and sheetings, intends to put in an electric light plant this summer as reported, but has not yet decided as to the system. Mr. A. F. Crouch is the superintendent. The factory is a fine large building, and will require a good equipment.

The Cincinnati Centennial.—The Laidlaw & Dunn Company, of Cincinnati, O., has been awarded the contract to supply two 7 by 28 feet Galloway boilers (300 h. p. each) and the pumps to supply the same for the Electric Lighting Department in Washington Park, at the coming Cincinnati Centennial Exposition.

West Washington. D. C.—A bill is being introduced in Congress to incorporate the West Washington Electric Lighting, Heating, Motor and Power Company. The incorporators are J. Chandler, F. W. Royce, C. H. Jackson, G. W. Wilson, D. I. Murphy, H. P. Gilbert, G. Hill, Jr., J. M. Gaffey and J. S. Humbird.

Washington, D. C.—The Washington & Virginia Underground Conduit and Construction Company has applied to the Commissioner of the District for permission to lay underground wires for electric light and power in several streets. Service at reduced rates is promised. Mr. R. W. Tyler is president of the company.

Lighting by Primary Batteries.—The Mason-Wood Electrical Manufacturing Company, of New York, has been incorporated by J. H. Mason and others, with a capital stock of $100,000. The object of the company is to do lighting, etc., by means of primary batteries, a plant of which is now on view at 56 Myrtle avenue, Brooklyn.

Removal of Factory.—A special dispatch from Indianapolis says: The arc light branch of the Jenney Electric Light Company, of Fort Wayne, has finally determined to locate at Plymouth. The company requires a donation of $15,000 in cash, ten acres of ground and a floating of $115,000 of the stock of the company. The citizens have, with but little effort, succeeded in meeting this seemingly large requirement.

Texas.—In a recent interview with a reporter of the Pittsburgh *Dispatch*, Mr. W. Lee Church said. "Texas is advancing in the use of electric light very rapidly; we have more central stations there than in any other state of the Union. The chief reason for this appears to be that the cost of coal there is considerable, which makes artificial gas correspondingly expensive."

Montgomery, Ala.—The Adams cotton mills, manufacturers of osnaburghs, will carry out their intention of lighting their mill by electricity, and contemplate putting in a plant of 100 incandescent lamps of 16 c. p. and a 10 h. p engine. Mr. J. R. Adams is president of the company, Mr. J. B. Sherrod secretary and treasurer, and Mr. W. L. Dolphyn general manager.

Danbury, Conn.—The Danbury Electric Light Company, Mr. E. T. Wightman, superintendent, has lately introduced two 2-h. p. Baxter motors on the regular night arc circuit, and they are giving great satisfaction and pleasure. The company is now endeavoring to get enough work to allow it to run a day circuit for motors alone. It is said that the company is about to effect a consolidation with the local gas interest.

Theatre Lighting.—Dr. Renk, of Munich, has been experimenting on the utility of electric light, from a sanitary standpoint, in the National Theatre of Munich. He found that the electric light had hardly any influence on the deterioration of the air, whereas the gas-light raised the temperature of the room, deprived the air of its oxygen, and rendered it injurious by increasing the carbonic acid, especially in the higher regions.

Revere, Mass.—The North Shore Electric Light Company is making an effort to introduce the Thomson-Houston system of electric lights for Revere and Wintbrop. It proposes to furnish light for residences as well as for street purposes. The Revere Gas Light Company received a franchise from the town last winter, and it was expected that pipes would be laid this spring. It is generally conceded that the two companies will combine. A positive proposition has already been made by the North Shore Company to the authorities of Winthrop.

Waco, Tex.—The Waco Gas Company bought out the local Jenney plant on March 1, thereby securing the city contract until 1891. They will operate the two plants together, the gas-works being under the management of Mr. J. L. Brockenbrough, secretary, and the electric lights under that of Mr. W. H. Wiggins, formerly superintendent of the Jenney station. No change is to be made in the price of either kind of light. The electrical capacity is 110 arc lamps, most of which are taken. Mr. G. Clark is the president of the company, and Mr. H. C. Scott general manager and treasurer.

A Newspaper Office.—The fine office of the St. Louis *Post-Dispatch* is lighted by an Edison plant, with a dynamo of 300 16 c. p. capacity. The wiring is for 600 lights. One of the handsomest features of the establishment is the large illuminated clock, which, suspended from iron brackets far out from the front of the structure, tells the time, day and night, to travelers on Olive street and the neighbors far and near. The case of this splendid timepiece is of wrought steel; the dials, of thick ground glass, are four feet in diameter, with the figures in raised metal, gold painted and protected from the weather by an outside glass. At night the clock is illuminated from the inside with twelve electric lights of 20 c. p. each, which, aside from its usefulness, renders it a thing of beauty and a beacon of brilliancy to be seen from afar.

Detroit, Mich.—A special dispatch of April 17 from Detroit says: While Ameron Kratz was recently performing his duties on a high tower as trimmer for the Brush Electric Light Company he received a shock from what he had been told was a "dead wire," which shattered his nervous system so that he is unable to work. He brought suit for $25,000 damages against the company, which asserted that Kratz was negligent. To substantiate this they introduced as evidence in court a miniature

electric light tower, with which they tried to show that a careful man could not be injured as Kratz was. The latter asserted that it was not a fair test of the shock received by him, because electricity loses its severity when received by a person standing on a dry floor instead of the earth or an iron footing. The jury gave Kratz $10,000.

APPLICATIONS OF POWER.

Southington, Conn.—The Southington and Plantsville street railway is to be operated by electricity.

Rochester, N. Y.—An injunction has been granted restraining the Rochester Electric Railway Company from running past the property of Mrs. A. Eddy.

Wilmington, Del.—The Wilmington City Railway Company, President Wm. Canby informs us, have completed the extension of their system, a mile and a half, into the rural districts. They have adopted the Sprague electric railway system, which has been in fairly successful operation since the beginning of March. In conclusion Mr. Canby says: "We feel pretty well satisfied that it will be a success. The trolley has been giving us some trouble, owing to the curves and turnouts, but I think the Sprague Company will overcome the difficulty."—*St. Ry. Gaz.*

Larramie, Wyo.—The Laramie Electric Gas Light and Fuel Company is now running two 25 h. p. and one 20 h. p. and several smaller motors, all of Sprague make. They are on the 220 volt Edison circuits. The two 25 h. p. motors are driving a flour mill of 100 barrels capacity, and the 20 h. p. runs spike machines, nut pressers, bolt headers, lapping and threading machinery in a rolling mill. The three large motors earn together about $425 a month, while the rate for the smaller ones is about $15 per h. p. per month. The secretary and manager of the company is Mr. R. M. Jones.

PERSONALS.

Mr. George R. Ruthven, the agent of the Western Union Telegraph Company at Havana, Cuba, died on Friday, April 20.

Mr. H. W. Shurtz, of the Detroit, Mich., Edison Company, has been a recent visitor to New York for pleasure and business.

Col. Henry Flad, the well-known civil engineer of St. Louis, being asked for an expression of opinion on the subject, says that cable roads will soon be in use only where heavy grades occur. "I believe the electric motor and storage battery have come here to stay, and that all our street railroads, unless it is those having grades exceptionally heavy, will be operated by electricity."

Rev. J. L. Nott, of Hebron, Conn., is quite an electrician. As a diversion from his many clergical cares and labors, he has lately constructed a bichromate battery of 12 cells, an 18-cell battery of the acid gravity type, and a couple of electric motors, one of which is to pump water. He has also invented and made a new form of arc lamp. All this work has been done with few tools, and in the scant leisure of a clergyman who has 4 services a week, and 400 calls to make, in the year, besides various other engagements without number.

Mr. Leo Daft.—In order to give the public an idea of the manner in which electricity can be applied to power purposes, the Meriden, Conn., Street Railway Company, which has recently adopted the Daft system for its road, requested Mr. Daft to deliver a lecture on the subject. The lecture was given on April 18, under the auspices of the local scientific association. Mr. Daft had a dynamo placed in a factory near the hall, and then illustrated a very instructive address by a number of experiments with apparatus on the platform.

Mr. C. Edmund Kells has contributed to the *Dental Review* for March a very thorough and complete article on "Dental Electrics." Mr. Kells has made a specialty of the use of electricity in his profession and has obtained some notable results, of which the article gives an excellent account. Mr. Kells uses in his work at New Orleans the Edison current, driving a ⅛ h. p. C. & C. motor, which he speaks of as "perfectly satisfactory in every respect," and adds, "for over a year it has done its work with no attention save daily oiling."

Mr. G. S. Morton, of London, England, read a very interesting and instructive paper before the Buffalo Electrical Society on April 13, upon the Elieson electric motor, which has recently been shown in operation in Buffalo. It will be remembered that in this system the motor forms part of the gearing, and revolves in a horizontal plane, the spindle of the armature being prolonged in both directions, carrying upon one end the pinion which gears into a circular rack, and upon the other the counterway. The rack is so arranged that for every 1,000 revolutions of the armature the motor makes 100, connecting with the train of gearing that operates the car axles.

MISCELLANEOUS NOTES.

Boston Subways.—The ordinance granting subway privileges to H. E. Cobb and others was vetoed by Mayor O'Brien last week, as being illegal.

Cattle Slaughtering.—It is stated that electric cattle slaughtering has recently been carried out with great success at St. Petersburg.

Greenbush, N. Y.—The Electric Manufacturing Company, of Greenbush, N. Y., will shortly put on the market a new drill chuck of improved design. They are now putting in machinery for its manufacture.

Eclipses and Earth Currents.—During the eclipse of the sun in August last the earth currents in the cable between Vladivostock and Nagasaki suddenly increased in intensity, returning to their normal value at the end of the eclipse.

The Thomson Electric Welding Company has been incorporated, under the laws of Maine, with a capital stock of $500,000. Gen. W. F. Draper is president, and B. F. Spinney treasurer, who are directors with J. N. Smith, Elihu Thomson and H. A. Royce.

The Gilliland Electric Company, of Adrian, Mich., has lately closed the contract for the wood-work for the Edison phonograph and the mimeograph. The contract is a large one, and its rapid execution requires the most improved machinery. The wood-working tools will be procured from the Egan Company, of Cincinnati.

The Weston Instrument Company has been organized at Newark, N. J., by Edward Weston, F. O. Mathiesen and others, with a capital stock of $100,000, for the purpose of manufacturing the ingenious and beautiful electrical instruments on which Mr. Weston has lately been at work.

Photography.—James W. Queen & Co., of Philadelphia, have begun the publication of an excellent monthly called the *Science of Photography*, the name indicating its object and scope. It contains 24 large octavo pages, and is illustated. The editors are J. J. Fox, W. M. Sweet and X. Smith. We can cordially recommend the paper to electrical photographers.

A Useful Publication is now being issued by Mr. W. Byrnes, of Philadelphia, known as *Lock and Bell*. It is a monthly, and pays special attention to everything connected with the locksmith and bell-hangers' trade. The typography and illustrations are very good, and the contents of an eminently interesting and useful character. At the price of $1 per year it should find hosts of readers.

Medical Electricity.—At a recent meeting of the Lane Medical College at San Francisco, Dr. J. O. Hirschfelder delivered a very interesting lecture on the subject of "Electricity in Medicine," in which he pointed to the use of electricity as one of the most striking evidences of the great advance made in modern medical science. He concluded by saying, "In electricity we have a remedy whose variety of operation and whose efficacy stand second to none with which science is familiar."

The Advance of Electricity.—*Light, Heat and Power* calls attention to the fact that during the first three months of 1887 the records show that 15 gas and 17 electric lighting companies were organized in the Southern States; while during the first three months of this year there were 10 new gas companies and 42 electric light enterprises. In other words, in 1887 gas-lighting was 47 per cent. of the new work in this field, while in 1888 the percentage had fallen to about 19 per cent.

Another Electrical Contemporary.—In the field of electrical journalism the cry is, "still they come." The latest publication to appear is *The Electric Items*, issued by the American Press Information Bureau, of this city, with Mr. George H. Spring as editor. It is a neat four-page folder, about the size of a theatre programme, and is devoted to news items. It will come out twice a week, and will thus aim at giving freshly all the current news in very brief form. We cordially welcome our contemporary to a field in which a good paper is always highly appreciated.

Keraunography is the name of that branch of the photographic art or photographic principle which impresses pictures upon the human flesh by lightning. Instances have been frequently noted where the imprints of flowers, of figures and various images and pictures have been imprinted upon the human body by a flash of lighting. The writers upon this subject have carefully estimated the velocity of the force, which they state as 240,000 miles a second. Therefore, if this force ever comes to be used as a merciful means of executing criminals, it will traverse the length of a six-foot man in one four-hundred-thousandth part of a second!—*Public Opinion.*

Electric Stop Motions.—The demand for the electric stop motion drawing frames made by Howard & Bullough is increasing. Riley & Gray, Boston, the sole importers, have sent orders to the works already this year for about 700 deliveries which have been ordered by various mills in the New England States, amongst which are: The Albion Company, Albion, R. I.; Cohannet Mills, Taunton; Border City Manufacturing Company, Shove Mills, Stafford Mills, King Philip Mills, Fall River; Stark Mills, Manchester, N. H.; Warren Manufacturing Company, Warren, R. I.; Androscoggin Mills, Lewiston, Me,; Wamsutta Mills, New Bedford; Willimantic Linen Company, Willimantic, Conn.—*Boston Journal of Commerce.*

Drawbaugh Talk.—The Boston *Commercial Bulletin* says: "This microphone patent is all that the Drawbaugh people ever had to fight for, and that they have not rested in the conflict is evident from the fact which the writer learned this week, that the motion for a rehearing of the case has been prepared, and will probably be submitted to the court the second week in May. Several errors in law and fact have been noted, and one in particular so glaring and so material that the counsel for Drawbaugh are very confident the point of priority will be reheard. They even hope that the court may not be sharply divided upon the question of rehearing, so much weight do they attach to the particular error which the late Chief Justice Waite seems to have made so unaccountably."

The Moral of a Mishap.—The desirability of having more boiler capacity than is required to meet the immediate needs of the engine is well illustrated by the recent mishap at Reading, Pa. Shortly after seven o'clock one evening a number of electric lights went out, and others became dim. This was caused by the giving out of one of the boilers at the central station. It leaked so badly that the fires had to be drawn, and the two remaining boilers could not generate sufficient steam to run the plant properly. After a delay of about two hours and a half, steam was raised in another boiler, and the lights resumed their usual brilliancy. The extra boiler does not cost much to maintain, when it is not in use, and in this case it saved a great deal of inconvenience to those dependent upon it for light.—*Power-Steam.*

A Very Long Run.—With regard to the recent remarkable performance of an engine, Westinghouse, Church, Kerr & Co. say: "Very long runs made by steam engines are considered rare, and long runs have heretofore been considered several days, or a few weeks. The Westinghouse engine has increased this time in many instances to a number of months. The last public notice of a long run made by Westinghouse engine was a notable instance where a certain engine ran eleven months without stopping, at a speed of 300 revolutions. The most remarkable record, however, has recently developed in the Pittsburgh Gas Light Company, where a 10-horse Westinghouse engine ran continuously for thirteen months, running at about 500 revolutions per minute, and in that time making 288,000,000 revolutions without the throttle valve being shut, and it is still running. It seems to take Burgess to beat Burgess."

Improving the Ohio Falls.—A bill has been introduced in the Kentucky Legislature, as already noted in these columns, to incorporate the Ohio Falls Electric and Water Power Company. The incorporators are authorized to construct at some point in the Ohio River, at or below the mouth of Beargrass Creek, apparatus or machinery, whereby the current of the river may be utilized for the purpose of supplying motive power to the machinery, manufactures and the arts, and to machinery for the manufacture, generation and storing of electric currents. The corporation is authorized to distribute the said power and electric currents through or by means of wires, cables or other conductors and to supply said electric currents for lighting, motive power and other adaptable uses, and to charge such reasonable rent and compensation therefor as may be agreed upon; but at no time shall the charge be in excess of the prices in other cities. The capital stock is to be $2,500,000.

Tests of Electrical Welding.—Prof. A. E. Dolbear writes to the *American Engineering Record* as follows: "I have had made nearly a hundred tests of the tensile strength of electrically welded bars of iron, steel and other metals. The results were of such a character that I can state positively that with Thomson's welding process it is possible to weld both wrought iron and steel so that the weld is as strong as the same cross-section in another part of the bar, that the appearance of the fracture is fibrous for iron and generally granular for steel, the strength of this granular steel being on some samples as high as 125,000 pounds per square inch; that the process is such that the welding is homogeneous from necessity. I had a number of bars welded by an expert blacksmith, and a number of similar ones by the electrical process for comparison, with the result that the electrically welded bars were much stronger than those welded by the ordinary process. The bars were of various sizes, up to an inch and a half for iron and three-fourths of an inch octagon steel."

SPARKS AND FLASHES.

High Art.—A telegraph lineman, climbing to the top of a pole, found himself abreast of a sign painter, swung on a scaffold under the eaves of a house. The two exchanged compliments.

"You are engaged in high art, I see," said the lineman.

"Your politeness shows that you belong where you have climbed," said the painter—"above the masses."

Every Man to His Trade.—Distinguished burglar: "What do yer think o' this mean plan o' workin' gentlemen off by 'lectricity? Hangin' 's good 'nuff fer me, everytime."

Touts (unlucky horse jockey): "Well, I dunno. The thing has its good points. If there's anything exasperates a man after his race is run it's the thought that he lost it by a neck."

A Senatorial Battery.—The secret of Senator Brown's power is his magnetism. He may be called an electric dynamo. Last Wednesday, after the Senator had concluded his speech on tariff, which, by the bye, is troubling the low tariff folks mighty much, another gentleman and myself called on him. Being nearest him as he came into the marble room, he shook hands with me first. As he took my hand I felt a decided electric shock. When his hand was within an inch of the hand of my companion several sparks were seen to pass from the Senator's hand to the hand of the gentleman with me, and the gentleman, feeling a vigorous shock, quickly withdrew his hand. He immediately spoke of the shock, which the Senator himself had noticed. The sparks were distinctly seen by us.—*Augusta (Ga.) Chronicle.*

BUSINESS NOTICES.

The Shultz Belting Company, of St. Louis, has an order for a belt 140 feet long and 35 inches wide, from the Lancaster Mills, Mass.

Frames of every description for showcards and pictures can be had of William Levin, 37 Dey street. Quality and promptness guaranteed. Catalogue and estimates on application. A full line of elegant pictures low, for cash.

The Partz Electric Battery Company, of 1,723 Chestnut street, Philadelphia, have three batteries which they make a specialty of, namely, a motor, acid gravity and open circuit. Send for their catalogue. The results of three years' use are simply marvelous.

Jordan & Gottfried, 208 Canal Street, N. Y., carry a complete stock of iron and brass machine and wood screws, bolt cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Steam Pressure Regulators.—The Boston Heating Company have purchased recently 45 Curtis pressure regulators from ¼ to 3 in. in size, to reduce 400 street pressure to from 5 to 80 for heating and power. The larger ones control the pressure on the pumps at the central station.

Hine & Robertson, 45 Cortlandt street, N. Y., are pursuing a novel method of inducing electric light companies to try "Eureka" Packing. To every new customer ordering direct from them 15 pounds or more at regular price, 75 cents per pound, they will send a handsome 8-day calendar clock, 12 in. dial, 24 in. high, or set of brass oilers and tray, 6 pieces, best made. This is an easy way to secure one of these necessary articles and get a packing indorsed by the most prominent electric light plants.

OFFICE OF BURLINGTON GAS LIGHT CO.,
180 COLLEGE STREET, BURLINGTON, Vt., April 10, 1888.

Chas. A. Schieren & Co.

DEAR SIRS: We have used your link belts during the last four months on Armington & Sims engines and Brush dynamos, and are much pleased with the results.

We find we can run one more light per machine, and then maintain a stronger current than when using flat belts, and all bearing are perfectly cool, even when running from but one side of the engine. Respectfully, F. H. PARKER, Superintendent,

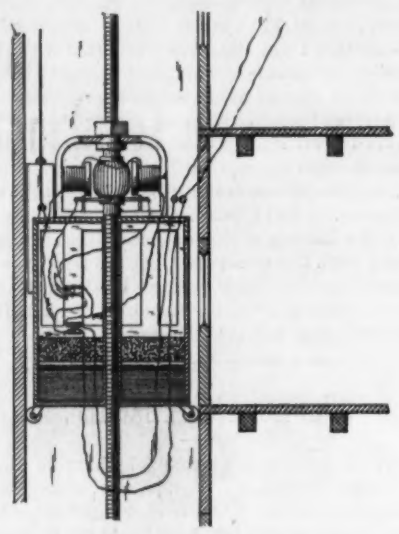
The Brush-Swan Electric Light and Power Co., Burlington, Vt.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED APRIL 17, 1888.

381,167. Reflector for Electric Lamps; Hiram Purdy, Burlington, Iowa. Application filed May 11, 1887. A reflector constructed in the form of an inverted truncated cone with laterally projecting curved reflecting plates and vertical radial reflecting plates. See illustration.

381,220. Static Compensator for Telegraphs; Minor M. Davis, Brooklyn, N. Y. Application filed May 4, 1887. In an apparatus where the secondary of an induction coil is used



381,492. ELECTRIC ELEVATOR.

to compensate for the effects of static charges and discharges, a condenser is located in a branch to earth from the primary.

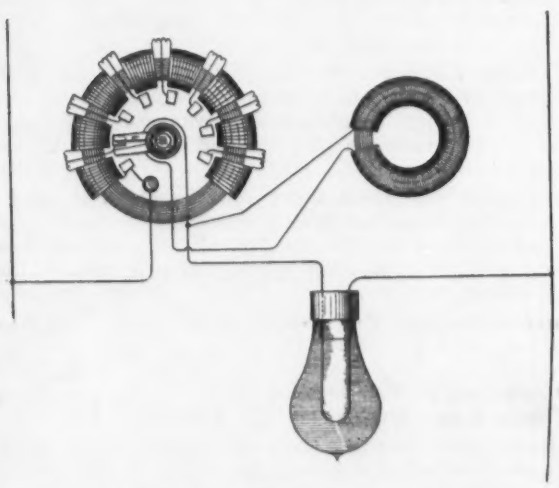
381,222. Electric Motor; Philip Diehl, Elizabeth, N. J. Application filed March 3, 1887. An electric motor is mounted beside a sewing machine so that the driving shaft of both shall be in line. The two shafts are then coupled by means of a crank.

381,228. Means for Regulating and Controlling Electric Motors; Bradley A. Fiske, of United States Navy. Application filed June 27, 1887. The movement of the motor is determined and regulated by a hand operated mechanism.

381,234. Telephone Transmitter; John M. Graham, Pittsburgh, Pa., Assignor to himself, Sarah C. Graham, Martha Graham and Thomas C. L. Graham, all of same place. Application filed May 12, 1887. Two pairs of contact springs are arranged to press opposite ends of electrodes carried by springs bearing on the diaphragm.

381,246. Telegraphy; Zeroy P. Hotchkiss, Oak Park, Ill., Assignor of one-fourth to Carlos J. Evard, same place. Application filed Feb. 14, 1887. A transmitting instrument in connection with a perforated strip sends over line pulsations of opposite polarity. These pulsations are received on an instrument which operates two punches and causes them to perforate a strip in accordance to the strip passing through the transmitter.

381,251. Dynamo Telegraphy; Francis W. Jones, New York, N. Y. Application filed Nov. 4, 1887. The invention consists of two simultaneously operating two-point keys, each connected at its front and back contacts, respectively, with sources of different polarity, and governing respectively the flow of currents of different tension to line, a two-point key being interposed between the double key and the line, having its



381,420. REACTIVE COIL.

front contact connected to one part of the double acting key, while its other contact is connected to the other part of said key.

381,254. Regulator for Electric Currents; Edward R. Knowles, Brooklyn, New York, Assignor to the Mutual Electric Manufacturing Company, of N. Y. Application filed April 22, 1886. A commutator is supplied with certain resistances, which are automatically operated with respect to the circuit by gearing connected with a pendulous armature interposed between magnets which set a right or a left hand train of gearing in operation when energized by a local circuit rendered operative through fluctuations of the main circuit.

381,260. Electro-Magnetic Spectacles; John Taylor Leighton, Edinburgh, Scotland. Application filed July 16, 1887. Patented in England Sept. 2, 1886. The bridge and other metallic portions of spectacles are wound with coils in circuit with a battery carried on the person. The magnetism is said to have a beneficial effect upon the nerves of the eyes and nose.

381,269. Electric Contact Changer; Preston C. Morse, Natick, Mass. Application filed Sept. 1, 1887. A rotating segment adapted to simultaneously break one circuit and make another. The well known "snap" switch is employed.

381,271. Slate for Telephone Desks; Emil T. Mueller, La Crosse, Wis. Application filed Jan. 28, 1888. A slate is secured to the desk of a telephone. It has attachments for the sponge, etc.

381,279. Electrical Registering Device; Samuel M. Pruden, Newark, N. J. Application filed May 27, 1886. A new device similar to those used in street cars for registering fares. The indicator is moved by the closure of a circuit.

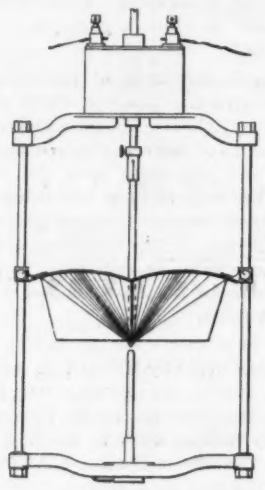
381,303. Electric Switch-Board; Richard H. Welden, Chicago, Ill., Assignor to himself and Joseph Calmeyn, same place. Application filed Sept. 6, 1887. A base or bed carrying a series of pins or posts is arranged in connection with a band to bring all the pins into a circuit simultaneously.

(1) 381,304. (2) 381,305. Electrical Coils and Conductors; Edward Weston, Newark, N. J. Applications filed Oct. 13, 1885. In rheostats, regulators, metres and electrical instruments generally where it is desirable to have coils whose resistances do not change with changes in their temperature, the coils are composed of different kinds of metal, one of which lowers the resistance of the coil when heated and the other raises it. The two thus balance and maintain the resistance constant.

381,314. Electric Belt; Frank B. Wood, New York, N. Y., Assignor to the New Haven Clock Company, of New Haven, Conn. Application filed April 29, 1886. The contact piece is a cam disc on a rotary shaft. By turning the shaft, the space between the spring and contact may be changed.

381,336. Galvanic Battery; Charles R. B. Claflin, Jr., and Joseph Walter Flagg, of Worcester, Mass. Application filed Nov. 17, 1886. The crystals of the exciting salt are placed in a receptacle, centrally located in the jar, and the positive and negative plates stand in vertical position around the same, alternating with each other and allowing spaces between them for the fluid.

(1) 381,343. (2) 381,344. Electric Train Signaling Apparatuses; John R. De Mier, Las Cruces, Territory of New Mexico. Applications filed March 10, 1888. Stationary



381,167. REFLECTOR FOR ELECTRIC LAMPS.

electric coupling sections are placed between the ends of the cars. These are connected up with the cord passing through the car. A novel form of coupler is used.

381,372. Apparatus for Electrolysis; Eugene Hermite and Chas. Cooper, of Pownall Road, Dalston, County of Middlesex, England, Assignors of one-third to Edward James Patterson, of same place. Application filed Oct. 25, 1887. Patented in England Feb. 8, 1887, No. 1,993. The bleaching and disinfecting qualities of chloride solutions are found to be enhanced by passing a current of electricity through them. After their strength has been spent they are electrolized and used again.

381,382. Telephone Transmitter; Edward H. Johnson, New York, N. Y. Application filed April 10, 1884. Patented in England Jan. 16, 1885, No. 652. The first claim is as follows: In a telephone transmitter, the combination with a sound receiving body and a stationary electrode of a movable electrode and a magnet armature, both carried by said sound receiving body, and an electro-magnet which is brought into action by a movement tending to separate the electrodes, and then attracts said armature in the direction to draw the electrodes together, substantially as set forth.

381,394. Commutator Brush for Electric Generators; Osborn P. Loomis, of Somerville, Mass., Assignor to the Loomis Electric Manufacturing Company, of New York, N. Y. Application filed Dec. 15, 1886. A plurality of sheet metal strips are arranged diagonally to the plane of the brush. The end remote from the commutator is soldered to a single piece. This construction gives large bearing surface and sufficient flexibility.

381,395. Electrical Railway; John C. Love, Philadelphia, Pa. Application filed Oct. 4, 1887. The underground conductors are laid in the upper part of the conduit, and the contact brushes, which when not in use are below the conductors, are adapted to be raised by a lever pivoted to the car.

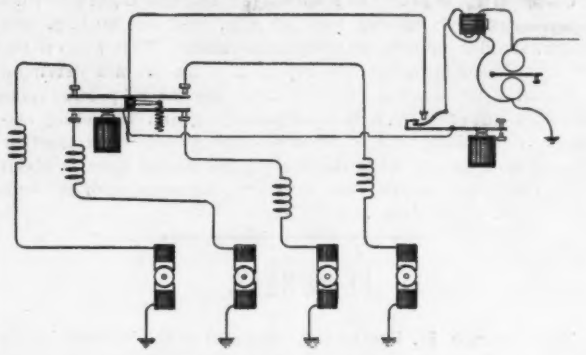
381,398. Dynamo-Electric Machine; Richard H. Mather, Windsor, Conn. Application filed March 3, 1887. A shunt wound machine having one of its pole pieces wound in the same direction as the field, and the other wound in the opposite direction. This prevents sparking, and maintains the brushes in a constant position.

381,420. Reactive Coil; E. Wilbur Rice, Jr., of Lynn, Mass. Application filed Oct. 28, 1887. In varying the power of an induction coil or other form of magnet coil on an alternating current circuit, the difficulties arising from opening the circuit temporarily or from the short circuiting of a portion of the coils are overcome by so combining and connecting with the switch a resistance or reactive coil, that when the switch is in an intermediate position where connection is made with both terminals of the coil, the said resistance shall be interposed in in the connection from one terminal to the other.

381,421. Dynamo-Electric Generator; Elias E. Ries, Baltimore, Md., Assignor of one-half to Albert H. Henderson, same place. Application filed April 28, 1887. Two ring armatures are arranged facing each other between the polar extensions of an exterior filled magnet, and an auxiliary field magnet is secured to and is supported by the exterior magnet, extending into the interior of both armature rings.

381,422. Electrical Indicator; Andrew L. Riker, New York, N. Y. Application filed Jan. 3, 1888. A curved solenoid, having a curved pivoted armature, is arranged in connection with a pointer, so that movements of the armature will be recorded by the pointer.

(1) 381,430. (2) 381,431. (1) Circuit for Double-Stranded Telephone Switch-Board Cords; (2) Long-Distance Connection for Multiple Switch-Boards; Charles E. Scribner, Chicago, Ill., Assignor of both to the



381,251. DYNAMO TELEGRAPHY.

Western Electric Company, of same place. Applications filed respectively Dec. 27, 1886, and Jan. 3, 1887. (1, Double-stranded cords are used, and the invention provides a connection between the different strands of the cord, which will be closed when either plug of the pair is inserted in a spring jack, so that the metallic circuit will be completed through the strands. (2) A simple arrangement, whereby the terminals of the "long distance" board may be readily connected with those of the "local" boards.

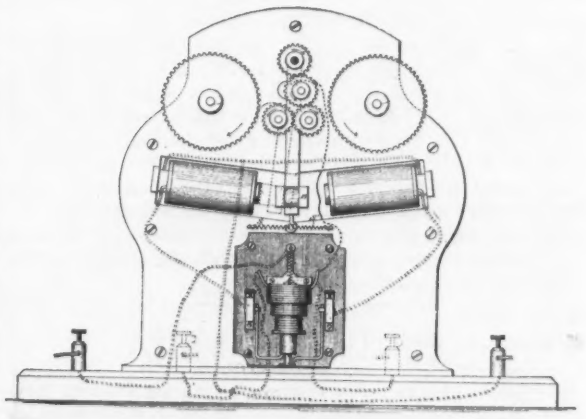
(1) 381,441. (2) 381,442. (3) 381,443. (1) Electric Meter; (2) Electro Mechanical Device; (3) Electric Meter; Elihu Thomson, Lynn, Mass. Applications filed respectively Oct. 19, 1887; Nov. 3, 1887, and Dec. 31, 1887. These inventions are based generally on the heating effects of a current of electricity. A current is passed through a wire or coil, and the heat generated thereby is utilized to volatilize a liquid such as ether or alcohol, and cause it to change its position with reference to certain mechanical arrangements. Such movements are registered upon dials and indicate the amount of current flowing. See page 214 this issue.

381,446. Switch, Circuit Breaker, etc.; John Von der Kammer, Newark, N. J. Application filed Feb. 18, 1888. Structural details which tend to cheapen the cost of construction and to provide an easily manipulated switch.

381,451. Dynamo-Electric Machine; Jonas Wenstrom, Orebro, Sweden. Application filed Feb. 10, 1886. A fan is located within the casing, and suitable chambers and passages are built in the machine to allow good ventilation.

381,459. Electric Valve Controller for Automatic Fire Extinguishers; Thomas Atkinson, Richmond, Va. Application filed Nov. 22, 1887. A sliding weight is located on an arm controlling the valve. The arm is normally held up by an electro-magnet and when the magnet circuit is broken the weight carries the arm down and moves the valve.

381,480. Electric Meter; Samuel D. Mott, New York, N. Y., Assignor by direct and mesne assignments to the Schuyler Electric Co., of Middletown, Conn. Application filed Aug.



381,254. REGULATOR FOR ELECTRIC CURRENTS.

24, 1883. Patented in England Sept. 29, 1882, No. 4,646. In an electric meter a balance wheel, a mechanical adjusting or regulating mechanism that may be set or adjusted to determine the natural rate of vibration or oscillation of said balance wheel, and an electro responsive device, such as an electro-magnet placed in the circuit of the current to be registered for setting or moving the adjusting or regulating mechanism to a point in its range of adjustment depending upon the strength of the electric current.

381,492. Electric Elevator; George C. Blickensderfer and John K. Hallock, Erie, Pa., Assignor to said George C. Blickensderfer, Trustee. Application filed April 13, 1887. A motor mounted on the top of the elevator has its armature shaft connected with a screw extending the full length of the shaft. A rotation of the armature causes the car to traverse the shaft.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.